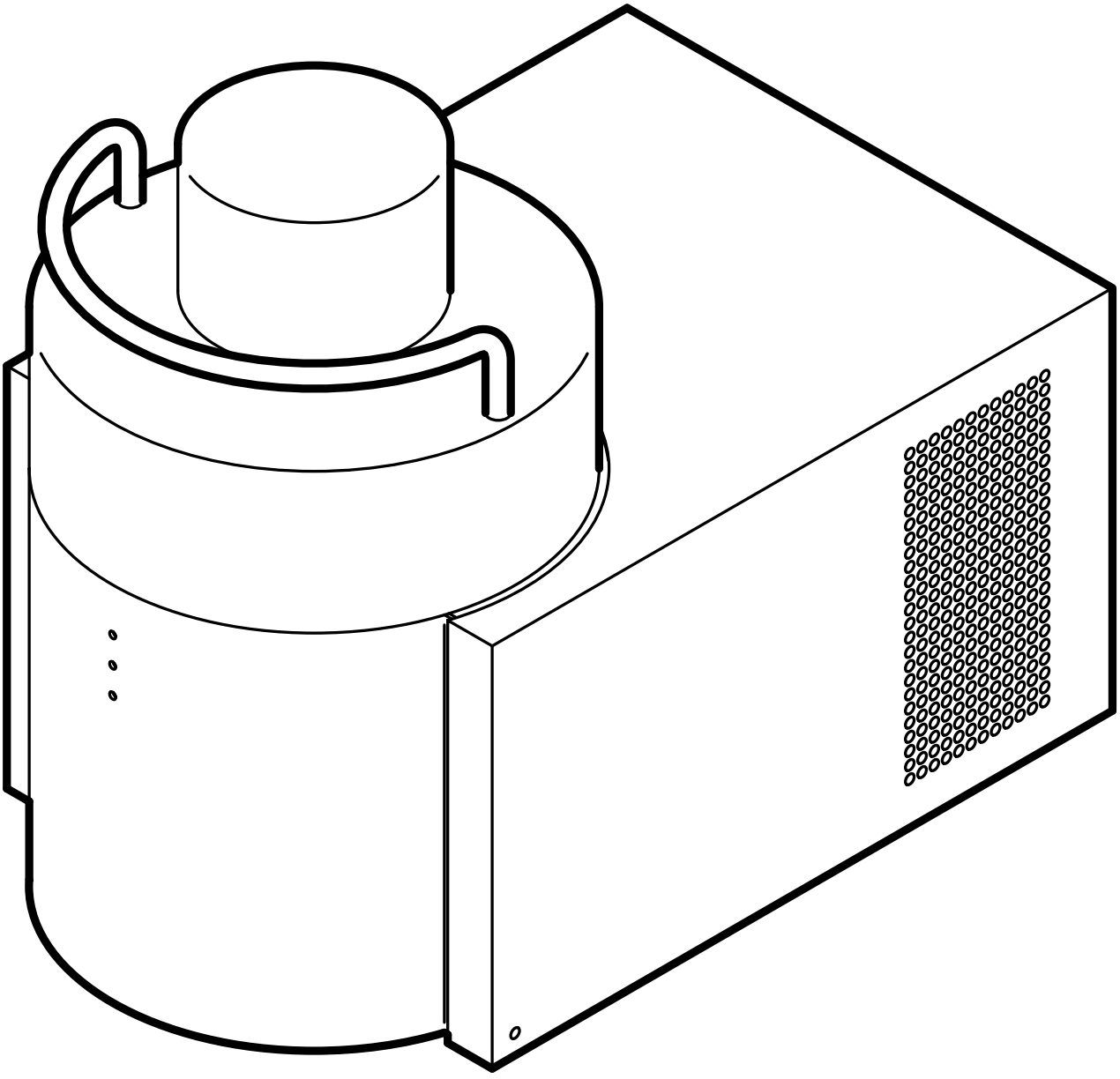
# Service Manual
# Light Cycler



Final 1.0 - January 1999

**Chapter 1 Application/Introduction**

**Chapter 2 Installation**

**Chapter 3 omitted**

**Chapter 4 Mechanics**

**Chapter 5 Electronics**

**Note: In some wiring diagrams the fluorimeter is termed photometer !**

**Chapter 6 Software**

**Chapter 7 Trouble Shooting**

**Chapter 8 Spare Parts**

**Chapter 9 omitted**

**Chapter 10 Maintenance**

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# 1 Application/Introduction

## 1.1 LightCycler Workstation

**Contents of the Workstation**

The LightCycler components are listed in the following table:

| Component | Description |
|---|---|
| System component 1 | · LightCycler™ Instrument<br>· Sample Carousel (for Ø 1.5 mm capillary), premounted in LightCycler™ Instrument |
| System component 2 | · Capillaries, (96 capillaries and caps/box)<br>· 32 Centrifuge adapters with 1 cooling block in an aluminium cooling block<br>· LightCycler™ Operator´s Manual<br>· Software Package<br>· Cable (to connect LC to computer)<br>· Power cord (German plug)<br>· Power cord (U.S. plug)<br>· Mouse Pad |
| Recommended PC Hardware /8/98 | · Vectra VE4 5/200 MMX Model 3200 Desktop<br>· Intel Pentium MMX processor, 200 MHz<br>· 64 MB SDRAM DIMM<br>· 3.2 GB ultra-ATA/33 hard disk<br>· On-board PCI vide: S3 Trio 64 V2, 2MB 50 ns DRAM<br>· 24x speed DIE CD-ROM disk drive<br>· Keyboard and PS/2 mouse |
| Operating system | Windows NT 4.0, including service pack III |
| ZIP drive | Internal Iomega ZIP drive, DIE interface (ATAPI) |
| Monitor | HP Ergo 1280, 17" monitor (HP# D2840A) |
| Printer | HP Deskjet 890C Color Inkjet Printer |

Tab.: cap1-1

**Marks of Conformity**

The LightCycler™ has been manufactured in accordance with EN 61010-1 (Safety Regulations for Measuring, Control and Laboratory Instruments; Part 1: General Requirements (IEC 1010-1 + A1: 1992, modified) and has been checked according to all relevant safety standards prior to leaving the factory.

The instrument has been approved for use by recognized testing institutions.

This is confirmed by the following test/conformity symbols:

| | | |
|---|---|---|
| GS | | Certificated by VDE institute (Association of German Electrotechnical Engineers) |
| CE | | The instrument conforms to current directives as issued by the European Union |
| UL | | Certificated by Underwriters Laboratories Inc. |
| CUL | | Certificated by Underwriters Laboratories for Canada – a testing facility recognized by the Standards Council of Canada (SSC) |

Tab.: cap1-2

All equipment to be connected must fulfill the standards set by IEC 950 (Safety of Information of Technology Equipment, Including Electrical Business Equipment).

**Classification**

- ISM instrument, medium-sized, for industrial, laboratory and domestic use.
- The instrument is designed for stationary operation.
- Any false measurements produced are irrelevant from the safety point of view.
- The instrument is designated for worldwide marketing.
- It is intended for evaluating pre-processed biological material.

The following should be noted:

- The instrument may not be used in conjunction with infectious material without additional safety measures being taken.

## 1.2 Technical Data

### 1.2.1 Instrument Specifications

**General Data**

| | |
|---|---|
| Dimensions | Height 45 cm<br>Width 30 cm<br>Depth 45 cm |
| Weight | 20 kg |
| Power supply | 110-240 V ± 10%, 47-63 Hz |
| Wattage | 800 W |
| Noise acc. to DIN 43635 | < 80 dBA |
| Heat emission, including PC, monitor and printer | Max. 860 kcal/h |
| Safety symbols | CE, GS, UL, CSA or CUL |

Tab.: cap1-3

**Environmental Parameters**

| | |
|---|---|
| Temperature during operation | 15 – 35°C |
| Temperature required during operation to maintain specifications | 15 – 30°C |
| Temperature during transport/storage/packaging | 20 – 60°C |
| Relative humidity | 20 – 80% |
| Altitude / pressure | 0 – 2000 m above sea level1030 – 850 hp |

Tab.: cap1-4

**Samples**

| | |
|---|---|
| No. of samples | 32 |
| Sample volume | 2 – 20 µl |

Tab.: cap1-5

### 1.2.2 Application Specifications

**PCR Temperatures**

| | |
|---|---|
| Temperature range | 40 – 98°C |
| Temperature accuracy of measuring system | ± 0.3°C |
| **Heating rate** | |
| Heating rate 40 – 95°C, step 40 – 95°C, time 10 – 90% | 8s |
| Heating rate 50 – 72°C, step 50 – 72°C, time 10 – 90% | 4s |
| Heating rate 72 – 98°C, step 72 – 95°C, time 10 – 90% | 5s |
| **Cooling rate** | |
| Cooling rate 95 – 40°C, step 95 – 40°C, time 10 – 90% | 8s |
| Cooling rate 95 – 60°C, step 95 – 60°C, time 10 – 90% | 4s |
| **Temperature stability** | |
| Temperature stability with respect to time, 95°C | +1°C / -0.5°C range |
| Temperature stability with respect to time, 65°C | +1°C / -1.0°C range |
| Temperature stability with respect to time, 40°C | +1°C / -0.3°C range |
| **Temperature homogeneity** | |
| Temperature homogeneity over all capillaries and time, 95°C | ± 1.5°C range |
| Temperature homogeneity over all capillaries and time, 65°C | + 0.7°C / -1.5°C range |
| Temperature homogeneity over all capillaries and time, 45°C | + 1.5°C / -0.5°C range |

Tab.: cap1-6

**Temperature Gradients**

| | |
|---|---|
| **Temperature gradient 0.1 °C/s, 0.2°C/s** | |
| Temperature homogeneity for one capillary, 70 – 95°C | ± 1.5°C range |
| Temperature homogeneity for one capillary, 50 – 70°C | ± 1.0°C range |
| Temperature homogeneity for one capillary, all positions, 70 – 95°C | ± 2.0°C range |
| Temperature homogeneity for one capillary, all positions, 50 – 70°C | ± 1.5°C range |
| **Temperature gradient 1.0 °C/s** | |
| Temperature homogeneity for one capillary, 70 – 95°C | ± 2.0°C range |
| Temperature homogeneity for one capillary, 50 – 70°C | ± 2.0°C range |
| Temperature homogeneity for one capillary, all positions, 70 – 95°C | ± 3.0°C range |
| Temperature homogeneity for one capillary, all positions, 50 – 70°C | ± 3.0°C range |
| **Temperature homogeneity for control of temperature peaks** | |
| Stability at 95°C for dynamic cycles, 72 – 95 – 50°C, 0s maintained | +2.0°C / -1.0°C range |
| Homogeneity of capillary /capillary at 95°C for dynamic cycles, 72 – 95 – 50°C, 0s maintained | +3.0°C / -1.0°C range |
| **Temperature homogeneity in capillary** | |
| 20 µl, 70°C | ± 1.0°C range |
| 15 µl, 70°C | ± 0.5°C range |

Tab.: cap1-7

### 1.2.3 Detector Specifications

**Illumination**

| | |
|---|---|
| Type | LED |
| Median wavelength | 470 nm |
| Output at 470 – 490 nm | 0.1 mW |

Tab.: cap1-8

**Detector**

| | |
|---|---|
| Type | Photohybrid |
| Receptor surface | 2.5* 2.5 mm² |
| Sensitivity at 520 nm, 20 µl sample volume | 15 nM fluorescein (1s) |
| Sensitivity at 650 nm, 20 µl sample volume | x nM fluorescein /LightCycler Red 640 |
| Sensitivity at 700 nm, 20 µl sample volume | x nM fluorescein / n.d. |
| Electronic dynamic | 12 bit |
| Electronic bandwidth | 1 kHz |
| Integration time | 20 ms |
| Alteration of amplification range | Factor 1 – 256 |

Tab.: cap1-9

**Filter**

| | |
|---|---|
| Detector 1 | Bandpass 520 nm HBW 20 nm, dichroitic |
| Detector 2 | Bandpass 645 nm HBW 30 nm, dichroitic |
| Detector 3 | Bandpass 710 nm HBW 40 nm, dichroitic |

Tab.: cap1-10

**Time**

| | |
|---|---|
| Measuring time for 32 capillaries | < 5s |

Tab.: cap1-11

## 1.3 System Description

### 1.3.1 The LightCycler

**Scheme of the Instrument**

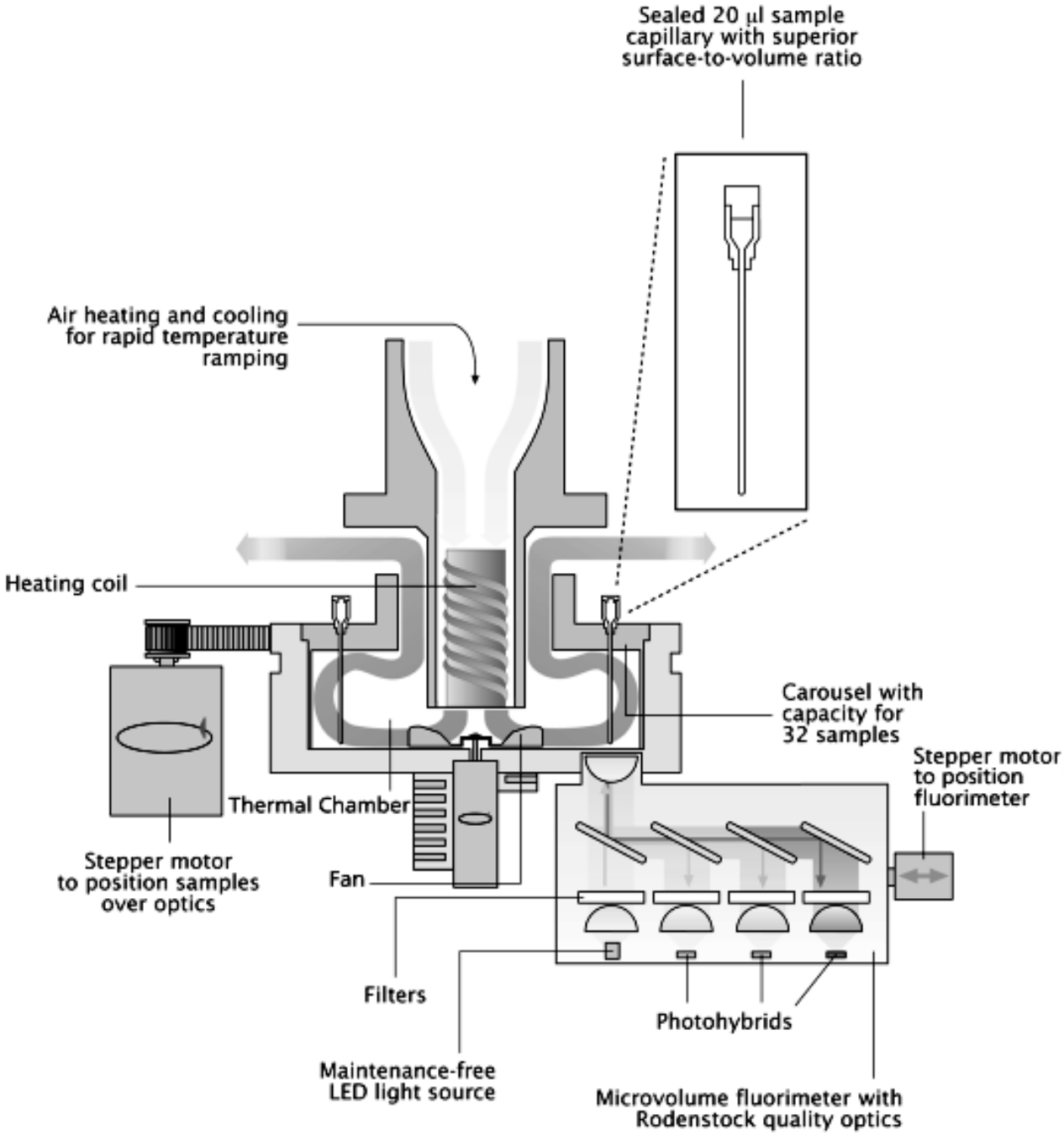
Sealed 20 µl sample capillary with superior surface-to-volume ratio
Air heating and cooling for rapid temperature ramping
Heating coil
Carousel with capacity for 32 samples
Stepper motor to position fluorimeter
Thermal Chamber
Stepper motor to position samples over optics
Fan
Filters
Photohybrids
Maintenance-free LED light source
Microvolume fluorimeter with Rodenstock quality optics

Fig. scheme1

**Description of the Instrument**

The sample capillaries are thermostatted with hot air in the thermal chamber; a ventilator ensures efficient aspiration, distribution and temperature homogeneity of the air during the heating process. During the cooling process, the ventilator operates at a higher speed in order to ensure adequate cooling. A heating coil controls the temperature.
For measurement, the sample rotor is propelled by a stepper motor; this brings the capillary tip precisely to the focal point of the photometer optics. The photometer itself is placed in a radial position in relation to the signal maximum in order to compensate for any radial deviation of the capillary tip.
3 microprocessors incorporated in the instrument control the process. Processor 1 is for communication, processor 2 regulates the temperature and processor 3 controls the measurement procedure as well as the rotor and photometer movements.
For online display, data are transmitted to the PC. Here, sample data are entered, the PCR reaction temperature is monitored, measurement modes and initial evaluation of melting point temperatures are carried out.

**Structure of the LightCycler**

The instrument comprises a basic lower and an upper unit.

| | |
|---|---|
| Basic Lower Unit | Thermo-chamber, photometer, drive units, circuit boards and power supply are located in the basic unit. The base of the unit is a 10 mm cast aluminum plate onto which the various elements are fixed. This guarantees stability, especially for the thermo-chamber and photometer. |
| Upper Unit | The upper unit contains the heating coil, an excess temperature sensor and a cooler with sectional converter. |

Tab.: cap1-12

**Thermo-Chamber Thermostatting**

Thermostatting is done by using hot and cold air. A sensor with thermal time constants identical with those of the capillaries provides reference values for control purposes. The process is controlled by varying the heating coil voltage. During the heating phase, only the ventilator in the thermo-chamber is in operation; this guarantees a high degree of temperature homogeneity. During the cooling phase, both the capillaries and the heating coil must be cooled. The ventilator is then operated at a higher speed.
2 sensors are incorporated in order to prevent excess temperatures:

| | |
|---|---|
| Sensor I | Sensor I is responsible for the temperature regulation. |
| Sensor II | Sensor II monitors the actual temperature. |

Tab.: cap1-13

**Fluorescence Photometer**

A 3-channel fluorescence photometer is used for detection purposes. Sample excitation is initiated by a blue LED with an emission maximum of 470 nm.
Fluorescence is detected by means of a separate photo-hybrid for each wavelength.

# 1.4 Introduction

## 1.4.1 Instrument

### 1.4.1.1 Principle of the LightCycler Technology

**System Description**

The LightCycler comprises two different instrument components: a cycler component and a fluorescence detection component. The combination of both components allows complex applications such as product analysis, quantification and mutation analysis.
The cycler component has been optimized for rapid PCR applications. Compared with classical PCR where typical cycling programs take several hours, PCR analyses carried out in the LightCycler can be completed in only 15-30 min. This considerable time saving effect is due to very short temperature transfer times, the so-called „ramping“ times, of the LightCycler instrument. „Ramping“ times are the time periods necessary to reach the next pre-set temperature of a „cycling“ protocol in a PCR experiment. An example is the transition from 94°C to 55°C after sample denaturation for primer hybridization during the annealing phase. This sort of high-speed cycling is made possible by an optimized surface / volume ratio of the samples and the use of air as a temperature transfer medium.

**Fluorimetric Detection**

The combination of an optimized thermocycler and a fluorimeter not only enables “online” presentation of the PCR data obtained and efficient analysis of results, but also offers the user utmost flexibility. To meet individual requirements, different detection formats can be used by choosing and combining fluorescent dyes and detection probes.
Fluorimetric detection of the PCR products formed consists of two different procedures:

- sequence-specific detection by the double stranded DNA binding dye SYBRÒ Green I, or
- sequence-specific oligonucleotides are coupled to suitable fluorophores as hybridization probes.

**Analysis of Results**

By means of the special LightCycler software, the data obtained from fluorimetric analysis can be evaluated and displayed. Additional cumbersome analytical procedures subsequent to PCR, e.g. restriction and gel analysis as well as blotting and hybridization experiments are no longer necessary. The direct and simple analysis of results also minimizes the contamination risk posed by samples and working materials due to a reduction of working steps required.

## 1.4.2 Instrument Components of the LightCycler

### 1.4.2.1 The Cycler Component

#### Sample Carousel

The central element of the cylindrical thermal chamber is the sample rotor. The rotor takes 32 samples in glass capillaries with a diameter of 1.55 mm and a length of 35 mm. PCR analysis carried out in these specially manufactured glass capillaries reduces the reaction volume to only 5 to 20 ml max. The optimized surface-to-volume ratio thus obtained allows for very short cycle times of only 15 to 20 seconds per cycle. The very favorable surface-to-volume ratio also guarantees an extremely rapid temperature change in the reaction mixture during each PCR cycle. At the same time, the glass capillaries serve as cuvettes for the fluorimetric determination of the PCR products formed.

#### Thermal Chamber

The cylindrical thermal chamber is supplied with hot air and air at ambient temperature by means of a fan with coupled heating coils. The incoming air is homogeneously distributed by a high-velocity fan at the base of the instrument, thus creating an even temperature throughout the reaction chamber. Surplus air is vented through an opening at the side of the chamber. The temperature is controlled by using an integrated measuring system with a temperature sensor installed in the direct vicinity of the sample capillaries of the sample carousel. The PCR thermal chamber is directly coupled to the optical system of the fluorimeter.

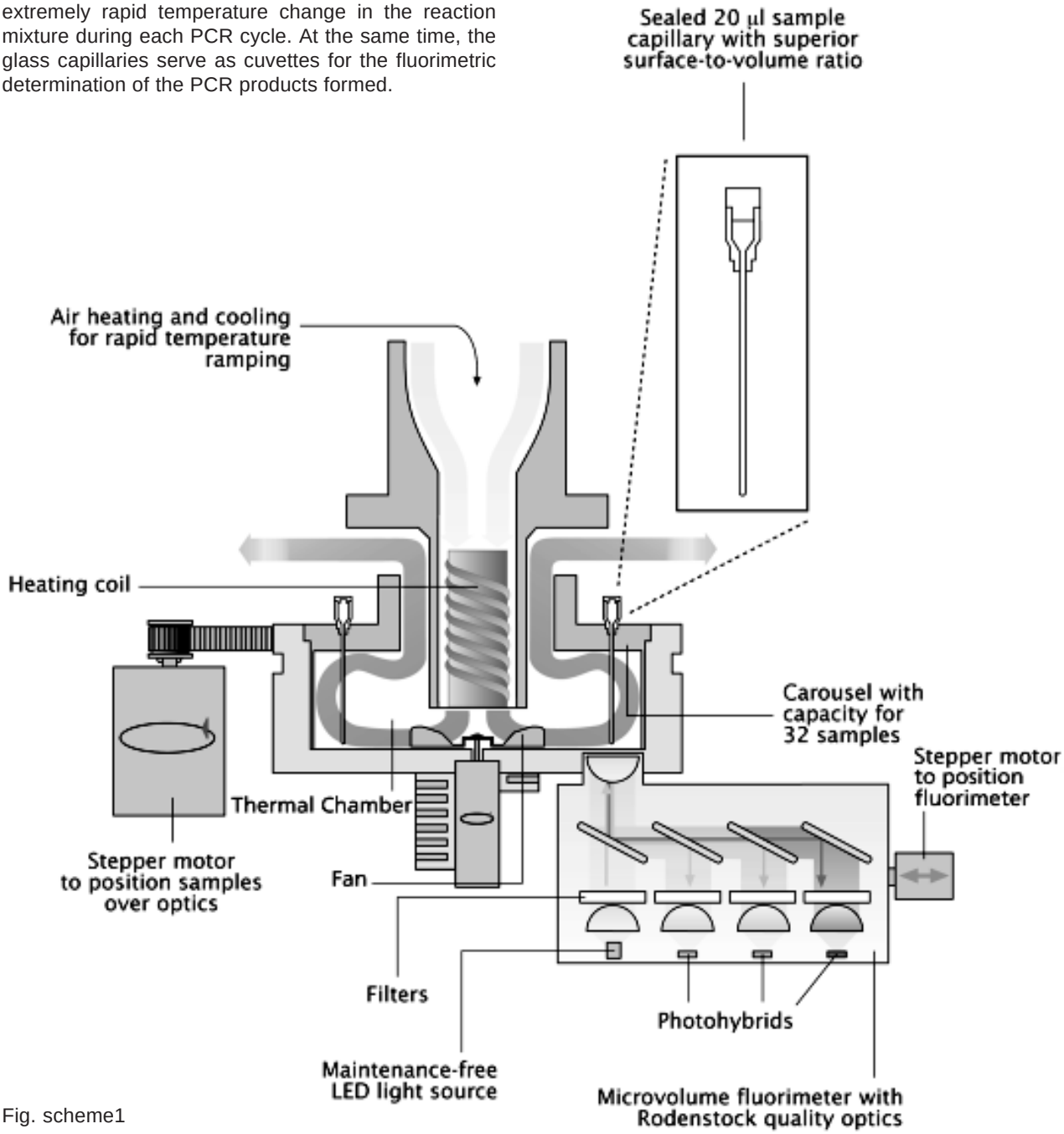
Sealed 20 µl sample capillary with superior surface-to-volume ratio
Air heating and cooling for rapid temperature ramping
Heating coil
Carousel with capacity for 32 samples
Stepper motor to position fluorimeter
Thermal Chamber
Stepper motor to position samples over optics
Fan
Filters
Photohybrids
Maintenance-free LED light source
Microvolume fluorimeter with Rodenstock quality optics

Fig. scheme1

### 1.4.2.2 The Fluorimeter Component

**Optics**

The fluorescent optical components of the LightCycler are schematically illustrated in chapter 1.3.1 The Light Cycler. A blue high-performance diode (blue LED) serves as energy source for sample excitation. The diode emits radiation which is spectrally filtered to a wavelength of 470 nm and an energy of 1 mW and is collimated (brought to the same wavelength) by means of a special optical system. The homogeneous light beam of 470 nm generated is subsequently focused onto the individual glass capillaries and then onto the samples to be measured in the sample carousel. The glass capillaries are moved by a high-precision stepper motor and placed in the optimal position for excitation and measurement. According to the spectral properties of the fluorophore used, the light emitted from the excited samples is guided into one of three channels (see drawing in chapter 1.3.1 The Light Cycler) via dichroitic mirrors for subsequent evaluation. In this channel, the emitted light beam is further collimated and spectrally concentrated by means of a special filter optical system. For final evaluation, the light beam is then focused onto a photomultiplier.
The three evaluation channels of the LightCycler are fitted with filter combinations. Thus, analysis at the given emission wavelengths is possible and exact sample measurement can be carried out in parallel with the fluorophores given in Tab.: cap 1-14:

| **Fluorophore** | **Excitation Channel** | **Analysis Channel** | | |
|---|---|---|---|---|
| | | **1** | **2** | **3** |
| | 470 nm±40 | 530 nm±20 | 640 nm±20 | 710 nm±40 |
| Fluorescein<br>SYBR Green I<br>LC-Red 640* | 490 nm<br>494 nm | 525 nm<br>521 nm | <br><br>640 nm | |

Tab.: cap1-14

**Table cap 1-14**

Specification of excitation and measuring channels of the fluorimeter component of the Roche Diagnostics LightCycler: Comparison of the spectral properties of selected fluorophores.

Abbreviations *: LC-Red = Light Cycler™ -Red 640
**: LC-Red is not excited by the blue LED, but is a FRET partner of fluorescein.

For further information, refer to the Operating Manual.

## 1.5 Warranty

**Processing of Warranty Claims**

A warranty claim has to be processed by way of the Return Authorization procedure or any accepted equivalent. Please answer all the questions on the RA form with the greatest care.
The warranty claim will only be accepted by the manufacturer if a **detailed fault description** is supplied. Complete instruments are accepted only in agreement with the Technical Product Management or with the responsible person of Roche Diagnostics Technical Support.

**Important Information:**

- Only parts marked with „**A**“ in the price list are generally accepted under warranty.
- Return only parts marked with „**R**“ in the spare parts price list.
- Warranty claim for “**R”** parts will be accepted, if the part has been returned to Mannheim.
- All defective parts ( **non-“R“** and **„A“** parts ) should be kept for a period of 7 months, should the manufacturer need to investigate the part, in which case it will be requested.
- All parts unduly returned to Mannheim will be sent back at the expense of each country's respective service center.
- RA warranty claims are accepted no later than 8 weeks after the **problem date**.

**Exclusion from Warranty**

The aforementioned warranties do not apply in case of improper use, handling, transportation or storage, faulty installation, repair or maintenance, chemical influence or contamination as well as damages resulting from that, failure to follow operating instructions, alterations or modifications of instruments or parts thereof not authorized or recommended by Roche Diagnostics and resulting damages, normal wear and tear and in case of other circumstances beyond the control of Roche Diagnostics.

**Repairs**

As a general rule, all instrument repairs should be carried out by authorized and trained personnel only.

**Repair of Parts Marked with „R“**

Parts which are worth repairing are marked with „R“ in the spare parts price list. New and repaired parts can be distinguished from each other by different material numbers (language version).

(e.g. new part: 1234567-**001**, repaired part: 1234567-**984**)

Repaired parts should be ordered together with new parts via the order processing department in Mannheim (OU-VDG). Defective parts should be returned together with order of repair, including the filled out RA form (giving full details of the defect and marked choice box with **repair**), to Logistic Instruments (Incoming Goods) in Mannheim-Wohlgelegen (LI-LV).

**Repair of Instruments**

Complete instruments are accepted only, if the problem is definitety located in the photometer unit. The replacement should have been agreed with the Technical Product Management or with the responsible person of the Roche Diagnostics Technical Support.

**Terms of Delivery**

Shipments to countries with the routine truck are **c.i.f./** other shipments are **ex works Mannheim** .

Emergency shipments incur additional charges.

**Charges**

**"Repaired" parts (material no. 1234567-984) are supplied at a "repair price. There will be a subsequent charge consisting of the price difference between a new and repaired part, should the defective parts not be returned within 3 weeks (for European countries) and 8 weeks (for Overseas countries).**

After receipt of a warranty claim for “**A**” parts, BMG will credit 100 % of the currently effective ex MA price.

In case the manufacturer does not accept the warranty claim, each country's respective service center will be charged the R-price for "R" parts and the new price for non "R" parts.

**RA Form**

**Return Authorization**

Please answer all the questions on the RA form with the greatest care and sign the form.

- Country code
- Problem date
- Type of instrument
- Serial no. of the instrument
- Installation date of instrument
- Defective instrument or spare part
- Part number and material number of the spare part
- Old / new serial no.
- Fault description
- Alarm code
- Service / workshop report no.

**Instruments Not Under Warranty**

- Installation date of spare part

All returned parts should be individually labeled with the corresponding RA no. and shipped together with the completed RA form to:

**Roche Diagnostics**
Logistic Instruments
RA Management
Friedrich Ebert Str. 100
D - 68167 Mannheim
Germany

**RA Form**

(Example)

**ROCHE DIAGNOSTICS GmbH**
Friedrich-Ebert-Strasse 100
D-68167 Mannheim
Germany
Telefon : +49 (621) 759 81 84
Fax : +49 (621) 759 80 93

## Return Authorization

**No**.:
Country code:
Date:
Instrument:
Serial No.:
Installation date:
Spare Part:

**Customer:** **Address:**

(will be filled in by BM)

| | | | | | | |
|---|---|---|---|---|---|---|
| Part No.: | Qty.: | Part Name: | | Repair | | Comments |
| Mat.-No.: | | | | Warranty | | |
| Installation date of Spare Part: | | | | Warranty Repair | | |
| **OLD** serial No.: | | | | Modification | | |
| **NEW** serial No.: | | | | Replacement | | |

**Fault Description:**

| | | | |
|---|---|---|---|
| **Alarm Code**: | | | |
| **Service Report No.:** | | **Workshop Report No.:** | |

Place: Date: Signature:

| | | | |
|---|---|---|---|
| **Remarks** (will be filled in by BM) | NOS | Credit | FC |

BM

# 2. Installation 2

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# 2. Installation

## 2.1 Installation Requirements

**Note**

- The LightCycler should not be set up next to instruments that cause electromagnetic interference or have high inductance, e.g. centrifuges or mixers.
- All connected peripheral instruments must fulfill the requirements of Standard IEC 950 (UL 1950).
- All plugs used in the LightCycler workstation (PC, printer, monitor) should have the same phasing in order to prevent switch-on peaks and electronic noise generated by other instruments or the power supply itself. Use of an appropriate distributor plug with the LightCycler workstation is recommended.

**Working Place Requirements**

See the following table for the working place requirements:

| | |
|---|---|
| Dimensions and weight | The LightCycler has a width of 30 cm, a depth of 45 cm and a height of 45 cm. It weighs approximately 20 kg. |
| Voltage requirements | The LightCycler operates on 120 – 240 V (50 – 60 Hz) and need not be adjusted. |
| Power consumption | The LightCycler requires approximately 800 W; PC and printer require a further 500 W. |

Tab.: cap2-1

**The LightCycler must not be opened by the user**

**The fuse may only be replaced if the instrument has been switched off at the mains.**

**Environmental Requirements**

Please refer to the following table for the environmental requirements:

| | |
|---|---|
| Ambient temperature | 15 – 35 °C (all specifications maintained between 15 and 30°C) |
| Humidity | 20 – 80 %, no condensation |
| Altitude | Sea level to 2000 m |
| Excess voltage | category II |
| Degree of contamination | 2 |

Tab.: cap2-2

**Storage Conditions**

The LightCycler™ can be stored on5 the following conditions:

| | |
|---|---|
| Ambient temperature | -20 - +60°C |
| Humidity | 20 – 80%, no condensation |

Tab.: cap2-3

## 2.2 Installation of the LightCycler

**Installation of the Instrument**

Please refer to the following table for the installation of the LightCycler instrument:

| Step | Action |
|---|---|
| 1 | Unpack the instrument. |
| 2 | Position instrument on bench, working surface. Allow 10 cm space left, right and behind. |
| 3 | Electrical connections:<br>- Connect LightCycler to the PC using an R 232 cable (serial inter-face).<br>- Connect LightCycler, PC, monitor and printer to same distributor plug. |

Tab.: cap2-4

⚠ **Ensure that printer, monitor and PC have been set to the correct voltage.**

## 2.3 Computer and Software Installation

**Installation of the PC**

After unpacking the computer, carry out the following steps:

| Step | Action |
|---|---|
| 1 | Connect mouse, keyboard and monitor to the computer. |
| 2 | Connect the LightCycler to the computer with an R 232 cable (serial interface). |
| 3 | Connect computer, monitor and LightCycler to the distributor plug.<br>The computer is now ready for operation |

Tab.: cap2-5

**Software**

The complete software package is installed by Roche Diagnostics.

**Installation of Updates / Reinstallation**

In the following table you find information about the reinstallation and loading of updates:

| Step | Action |
|---|---|
| 1 | Store any data, e.g. DATA, PROFILES and PROTOCOLs |
| 2 | Place LightCycler CD-ROM in appropriate disk drive (e.g. F) |
| 3 | Start set-up program (e.g. F:\SETUP.EXE). |

Tab.: cap2-6

## 2.4 LightCycler De-installation

**De-installation of the Instrument**

Please refer to the following table for the de-installation of the instrument:

| Step | Action |
|---|---|
| 1 | Switch off the instrument. |
| 2 | - Disconnect the RS 232 and power cables.<br>- Clean according to the chapter on service and decontaminate if necessary. |
| 3 | Dispatch instrument in its original packaging. |

Tab.: cap2-7

## 2.5 Operation and Maintenance of the LightCycler

**Guidelines for Operation**

- The instrument may be operated only if protected from the weather. It may not be operated in buildings without temperature regulation facilities. If necessary, additional drying agents may be used to eliminate humidity.
- The instrument should not be operated near dripping, spraying, splashing or running water.
- The instrument is thus suitable for use according to classification 3K3 in accordance with Standard EN 60721-3-3.
- The instrument may be used at locations subject to noticeable or significant vibration; however, it should not be exposed to higher levels of shock waves.
- The instrument is thus suitable for use according to classification 3M4 in accordance with Standard EN 60721-3-3. The instrument is able to tolerate vibrations up to classification 3M6. However, based on expected locations of use, no significant and permanent vibrations or shock waves are to be expected.

**Transport and Storage**

When storing or transporting the instrument, it should not be exposed to extreme cold, e.g. as in the case of air freight. Temperatures lower than –25°C should be avoided (damage to optical systems). The optical systems are equipped with open ventilation systems and should therefore be protected from dirt and humidity. There are no further specifications for transport and storage.

**General Maintenance**

The instrument is maintenance-free.

**Cleaning the Instrument**

- Use 70% ethanol for disinfecting the incubator.
- Use only alcohol and an optical cloth for cleaning the optical window.
- Use a mild commercial detergent for domestic use for cleaning the housing.

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# 4 Mechanics

## 4.1 Overview

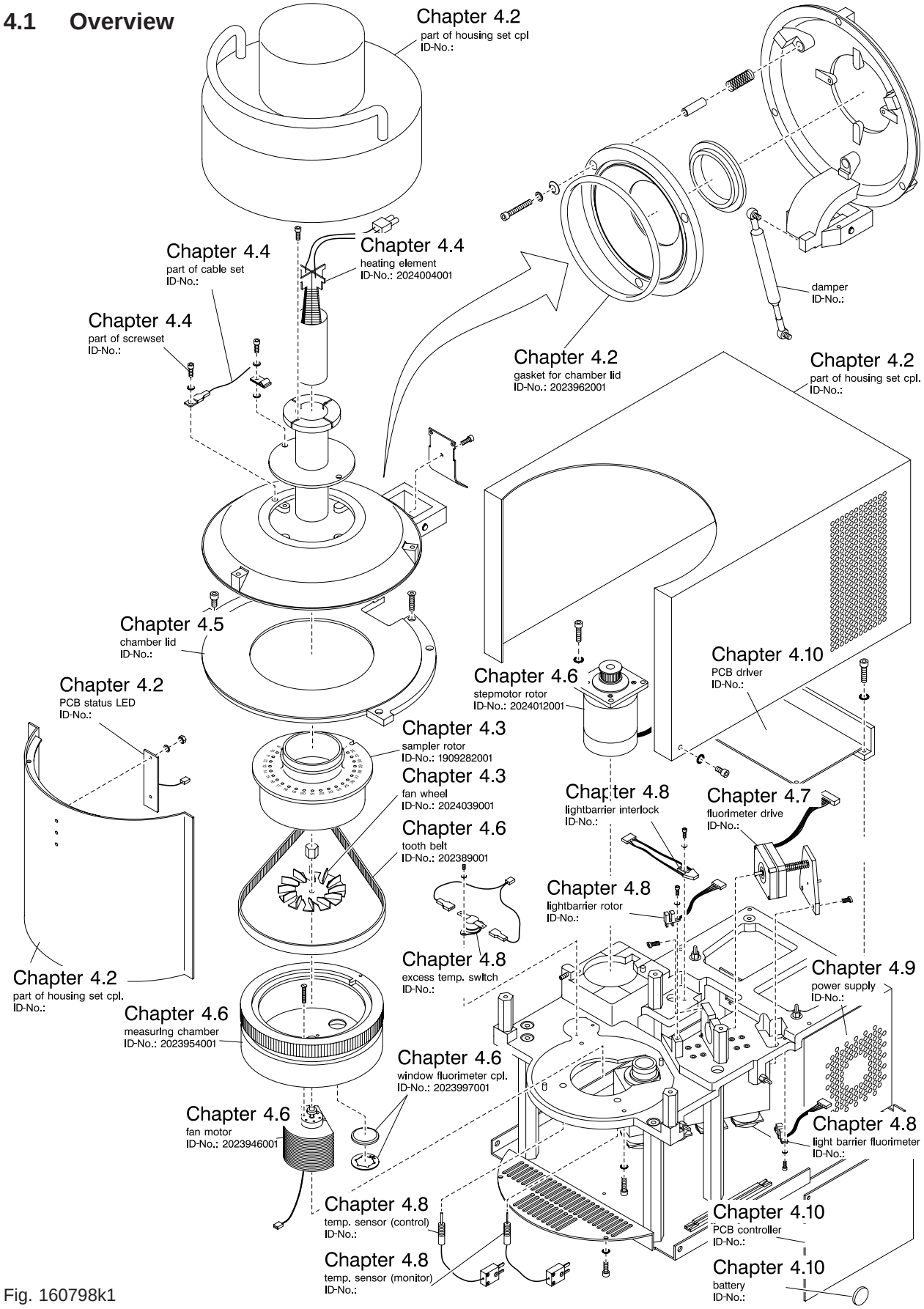



Fig. 160798k1

## 4.2 Disassembly of the Housing Parts

### 4.2.1 Housing Lid

#### 4.2.1.1 Location

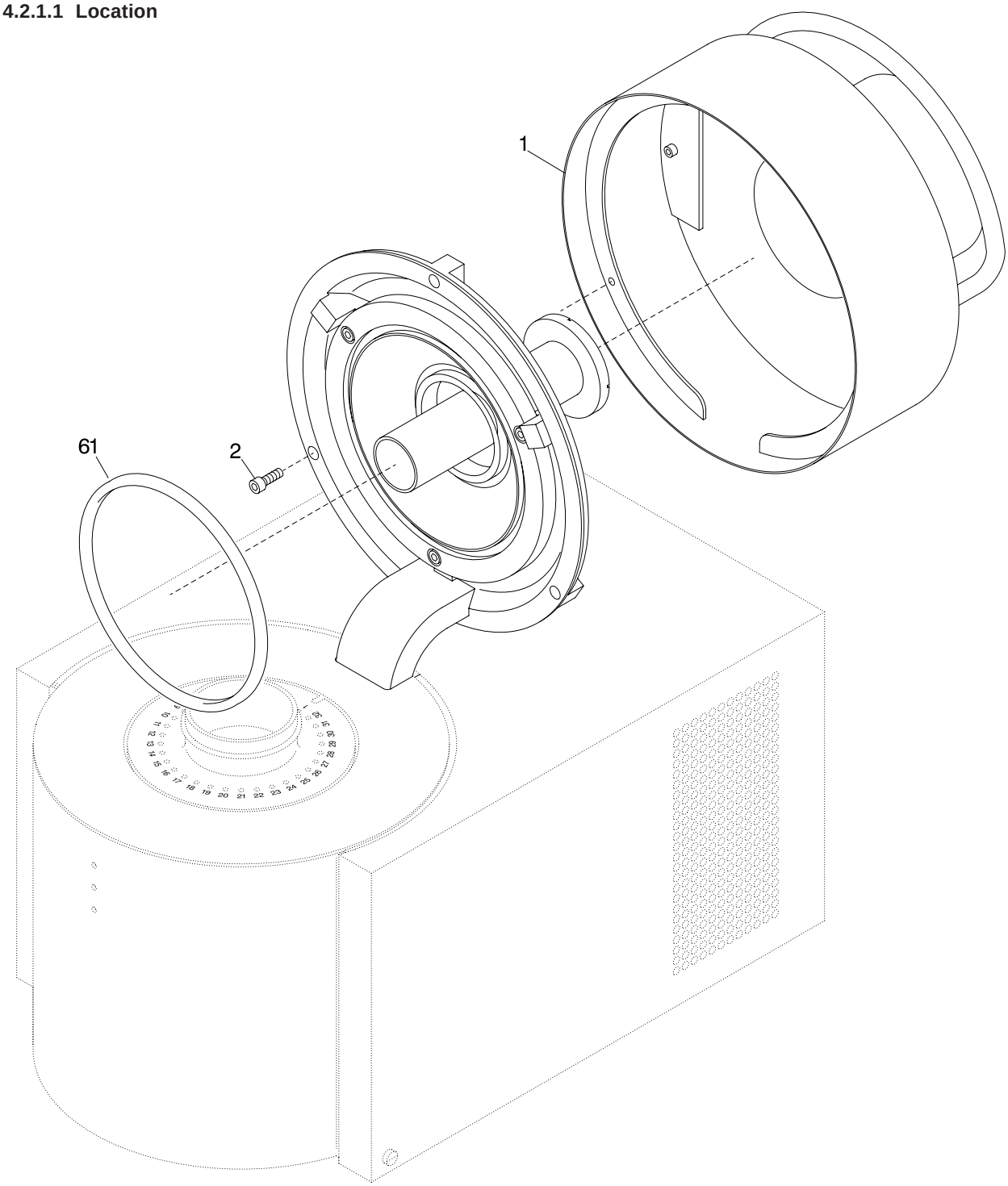



Fig. 140798k2

#### 4.2.1.2 Service Procedure

**Replaceable Components:**

- Housing lid (1) (is part of the housing set)
- Screw (2) (is part of the screw set)
- Gasket (61)

**Disassembly of the Housing Cover:**

- Flap housing lid (1) backwards
- Remove all screws (2)
- Remove housing lid (1)

**Disassembly of Gasket:**

- Flap housing lid (1) backwards
- Remove gasket (61).

### 4.2.2 Housing

#### 4.2.2.1 Location

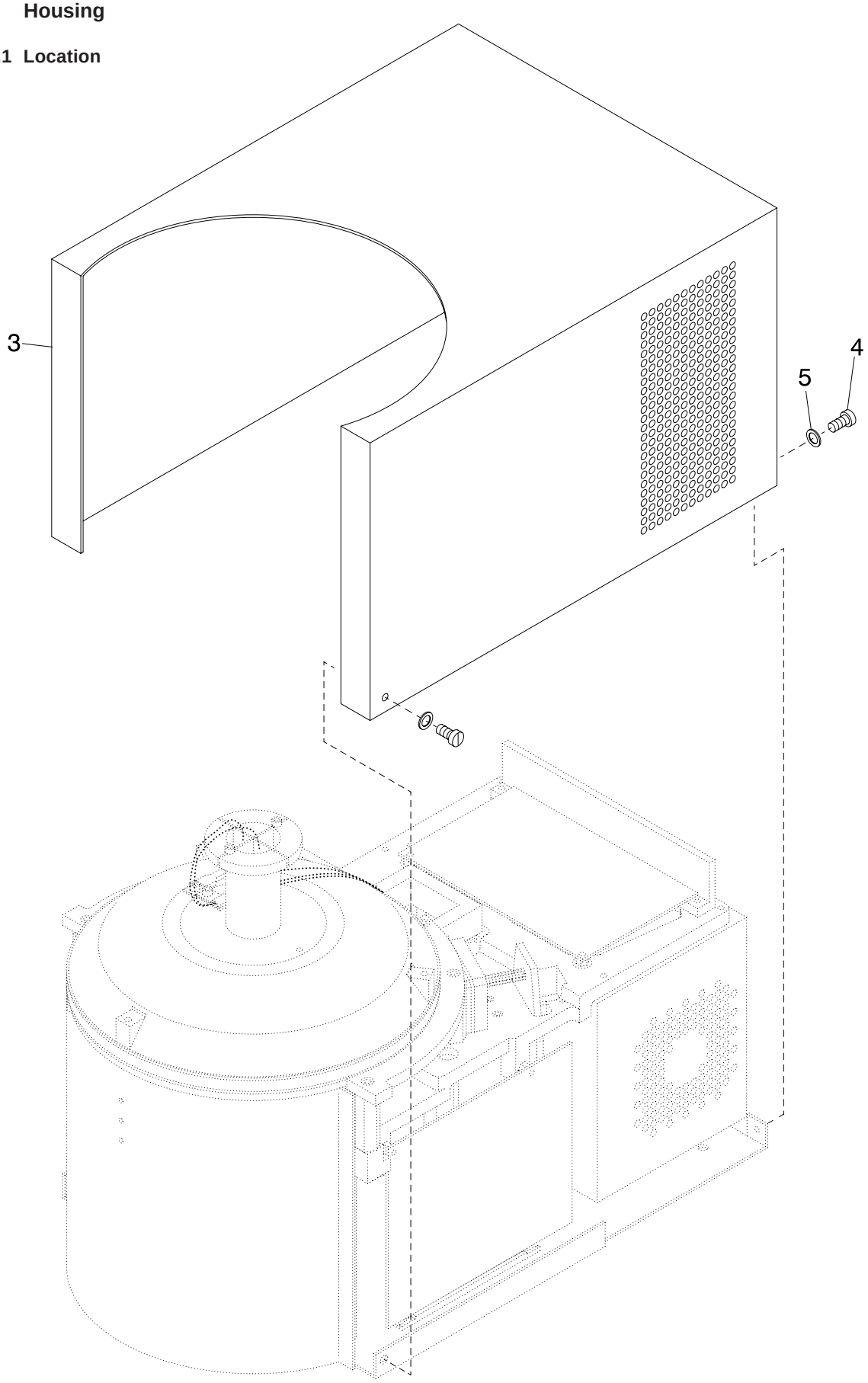



Fig. 151298k1

#### 4.2.2.2 Service Procedure

**Replaceable Components:**

- Housing (3) (is part of the housing set)
- Screw (4) (is part of the srew set)
- Washer (5) (is part of the screw set)

**Disassembly of the Housing:**

- Remove all the screws (4) with washers (5)
- Lift off housing (3)

**Note:**

Please take care that the edges of the cover (3) do not scratch the front of the cover (3)

### 4.2.3 Panel

#### 4.2.3.1 Location

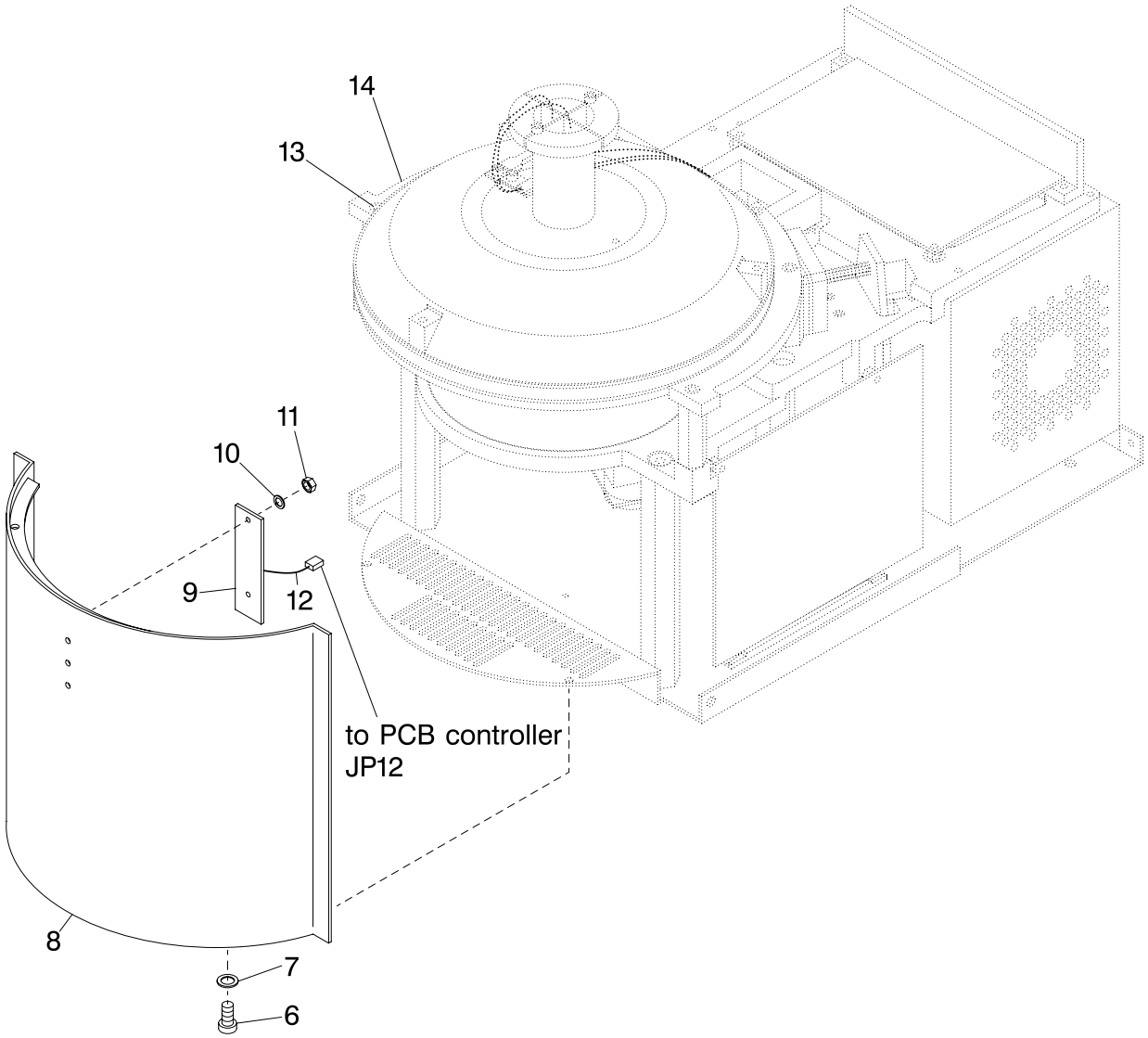



Fig. 140798k1

#### 4.2.3.2 Service Procedure

**Replaceable Components:**

- Screws (6) (are part of the screw set)
- Washers (7) (are part of the screw set)
- Panel (8) (is part of the housing set)
- Status board (9)
- Washers (10) (are part of the screw set)
- Nut (11) (is part of the screw set)
- Cable (12) (is part of the cable set)

**Disassembly of the Panel:**

- Remove housing,
  *see chapter 4.2.2*
- Loosen all screws (13)
- Remove all the screws (6) with washers (7)
- Pull cable (12)
- Lift chamber lid (14)
- Take off panel (8)

**Disassembly of the Status Board:**

- Disassemble the panel (8)
- Remove nuts (11) with washers (10)
- Remove status board (9)

#### 4.2.3.3 Wiring

Cable (12) connects status board (9) to PCB controller JP12, *see chapter 4.10.4*

## 4.3 Sample Rotor and Fan Wheel

### 4.3.1 Location

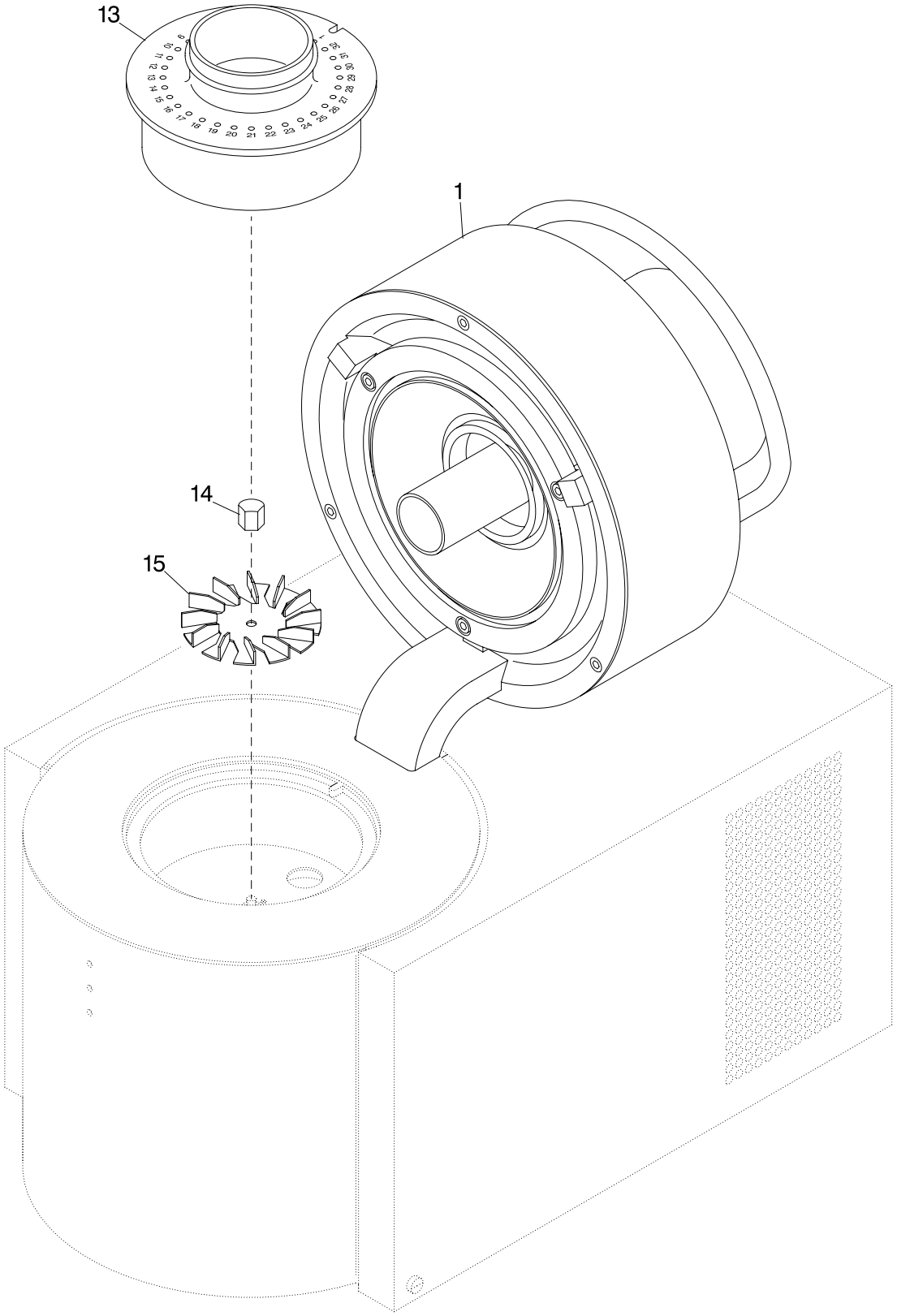



Fig. 140798k7

### 4.3.2 Service Procedure

**Replaceable Components:**

- Sample rotor (13)
- Fan wheel (15)

**Disassembly of the Sample Rotor:**

- Flap housing lid (1) backwards
- Remove sample rotor (13)

**Disassembly of Fan Wheel:**

- Disassemble the sample rotor (13)
- Remove nut (14)
- Remove fan wheel (15) by lifting it out

**Note:**

Do not tighten nut (14) too tight when mounting the fan wheel (15), or this might cause damage to the plastic fan motor thread.

## 4.4 Heating Element

### 4.4.1 Location

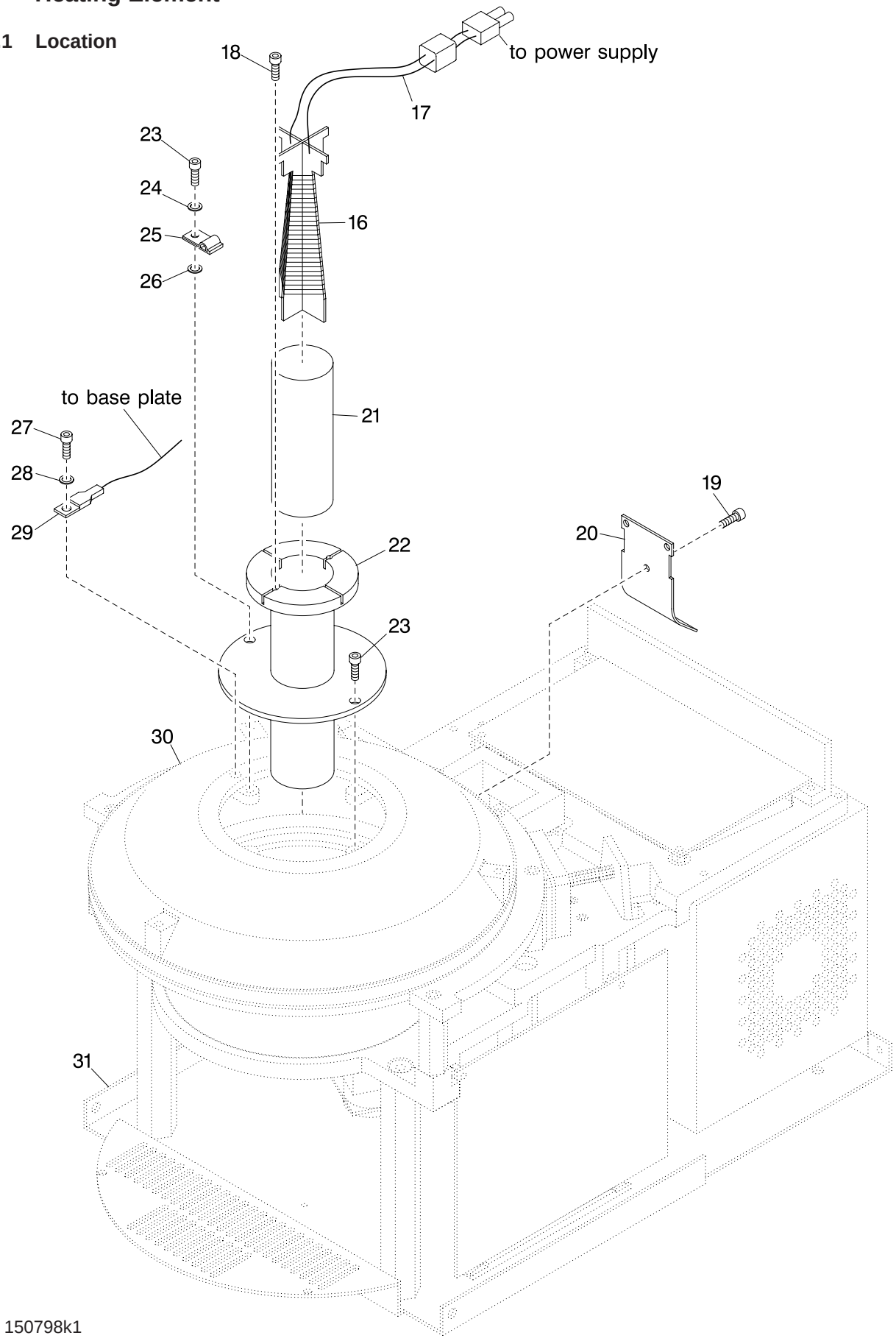



Fig. 150798k1

### 4.4.2 Service Procedure

**Replaceable Components:**

- Heating element (16)
- Cable (17) (is part of the cable set)
- Ground cable (29) (is part of the cable set)

**Disassembly of the Heating Element:**

- Flap housing lid (1) backwards,
  *see chapter 4.2.1*
- Disassemble the housing (3),
  *see chapter 4.2.2*
- Remove screw (23) with washer (24)
- Remove cable clip (25) with washer (26)
- Remove cable (17) from cable clip (25)
- Remove screws (18)
- Remove screw (19)
- Pull off cover sheet (20)
- Pull cable (17)
- Remove heating element (16) by lifting it out
- Remove sheathing (21) if necessary

**Disassembly of the Flange:**

- Disassemble the heating element (16)
- Remove screw (23)
- Remove flange (22) by lifting it out

**Disassembly of the Grounding:**

- Remove screw (27) with washer (28)
- Remove grounding (29)

### 4.4.3 Wiring

Cable (17) connects heating element (16) to power supply, *see chapter 4.9*

Ground cable (29) connects base plate (30) to lower part of the housing (31)

## 4.5 Chamber Lid

### 4.5.1 Location

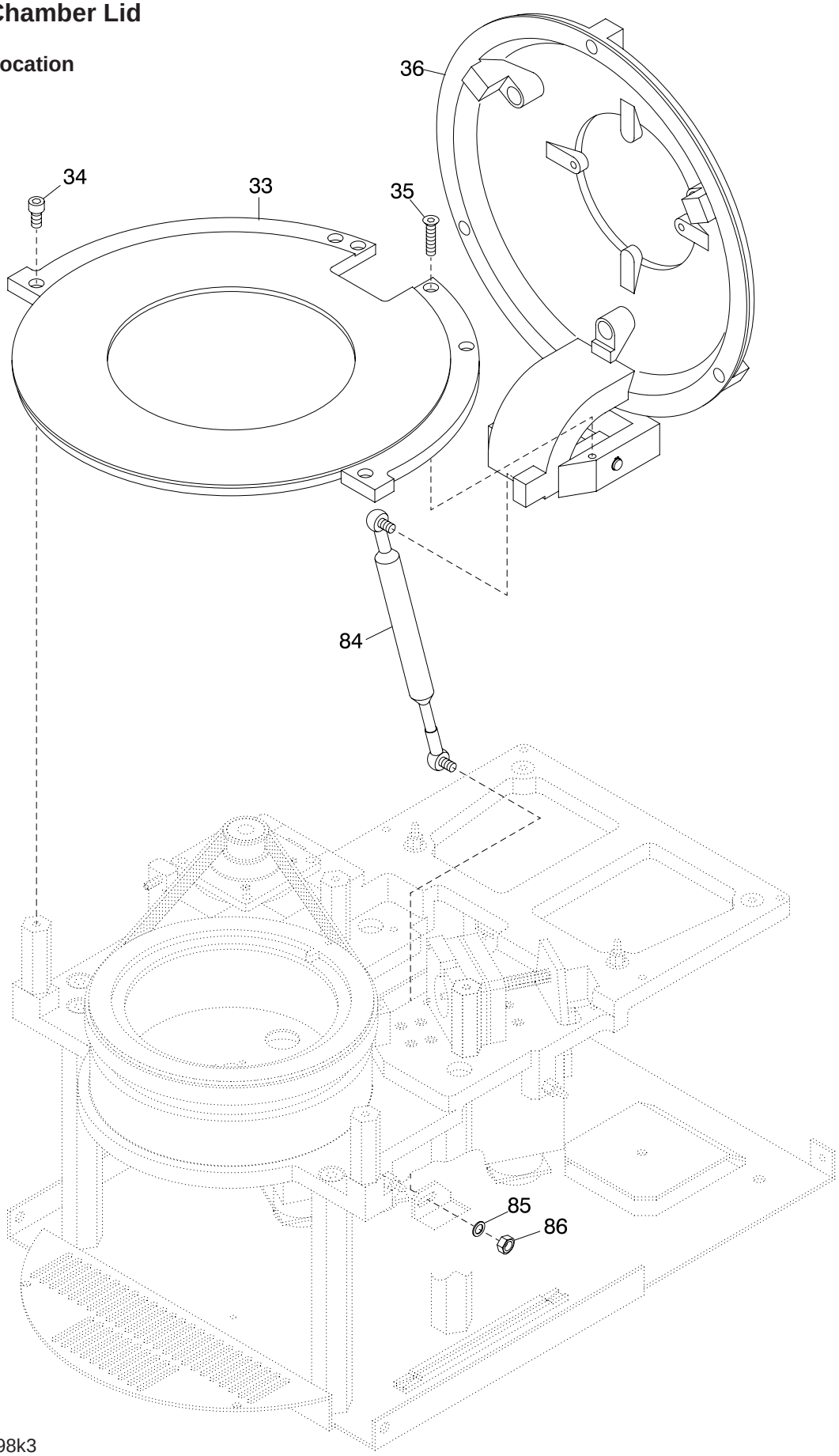



Fig. 140798k3

### 4.5.2 Service Procedure

**Replaceable Components:**

- Chamber lid (33)
- Damper (84)
- Screw (34) (is part of the screw set)
- Screw (35) (is part of the screw set)
- Washer (85) (is part of the screw set)
- Nut (65) (is part of the screw set)

**Disassembly of the Chamber Lid:**

- Disassembly of the housing parts,
  *see chapter 4.2*
- Disassembly of the heating element,
  *see chapter 4.4*
- Remove screws (34)
- Remove nut (86) and washer (85)
- Push damper (84) slightly to the side
- Lift out base plate (36) with chamber lid (33) and damper (84)
- Remove screws (35) and base plate (36)
- Unscrew damper (84) from base plate (36)

## 4.6 Rotor

### 4.6.1 Stepper Motor Rotor

#### 4.6.1.1 Location

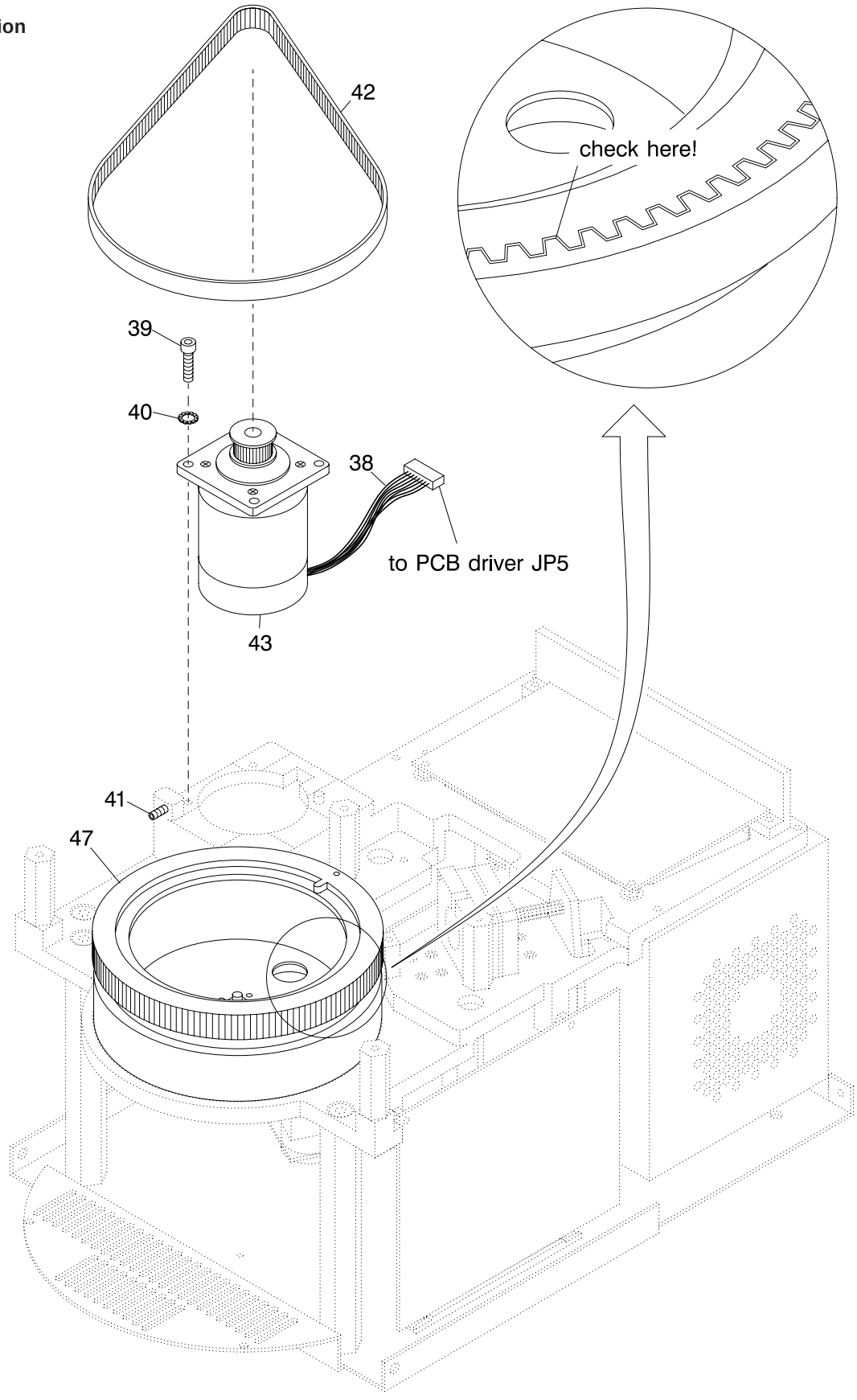



Fig. 151298k2

#### 4.6.1.2 Service Procedure

**Replaceable Components:**

- Stepper motor rotor (43)
- Tooth belt (42)
- Cable (38) (is part of the cable set)
- Screw (39) (is part of the screw set)
- Washer (40) (is part of the screw set)
- Set screw (41) (is part of the screw set)

**Disassembly of the Tooth Belt:**

- Disassembly of the housing parts, *see chapter 4.2*
- Disassembly of the heating element, *see chapter 4.4*
- Disassembly of the chamber lid, *see chapter 4.5*
- Pull cable (38) from PCB driver
- Remove screws (39) and washers (40)
- Turn set screw (41) in order to reduce tooth belt (42) tension
- Lift out tooth belt (42)

**Disassembly of the Stepper Motor Rotor:**

- Disassembly of the tooth belt
- Lift out stepper motor rotor (43)

#### 4.6.1.3 Wiring

Cable (38) connects stepper motor rotor (43) to PCB driver, *see chapter 4.10.3*

#### 4.6.1.4 Adiustments

Belt tension of the sample rotor drive

An adjustment of the belt tension is necessary if one of the following components is removed or replaced:
- stepper motor (rotor) (43)
- tooth belt (42)
- measuring chamber (47)

Proper adjustment of the belt tension ensures a minimum of friction between motor, belt and rotor.
To adjust the belt tension, please proceed as follows:
- Open the fixation screws (39) of the stepper motor (rotor) (43) about 1/4 of a turn, so that the motor can be moved in a horizontal direction
- Adjust the tension with the adjustment screw (41) until the teeth of the belt fit properly into the grooves of the rotor drive, see drawing

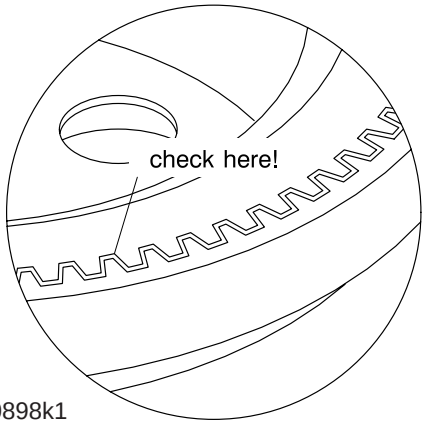


Fig. 030898k1

Fix the fixation srews (39) of the stepper motor (43) and check again for proper movement.

### 4.6.2 Fan Motor

#### 4.6.2.1 Location

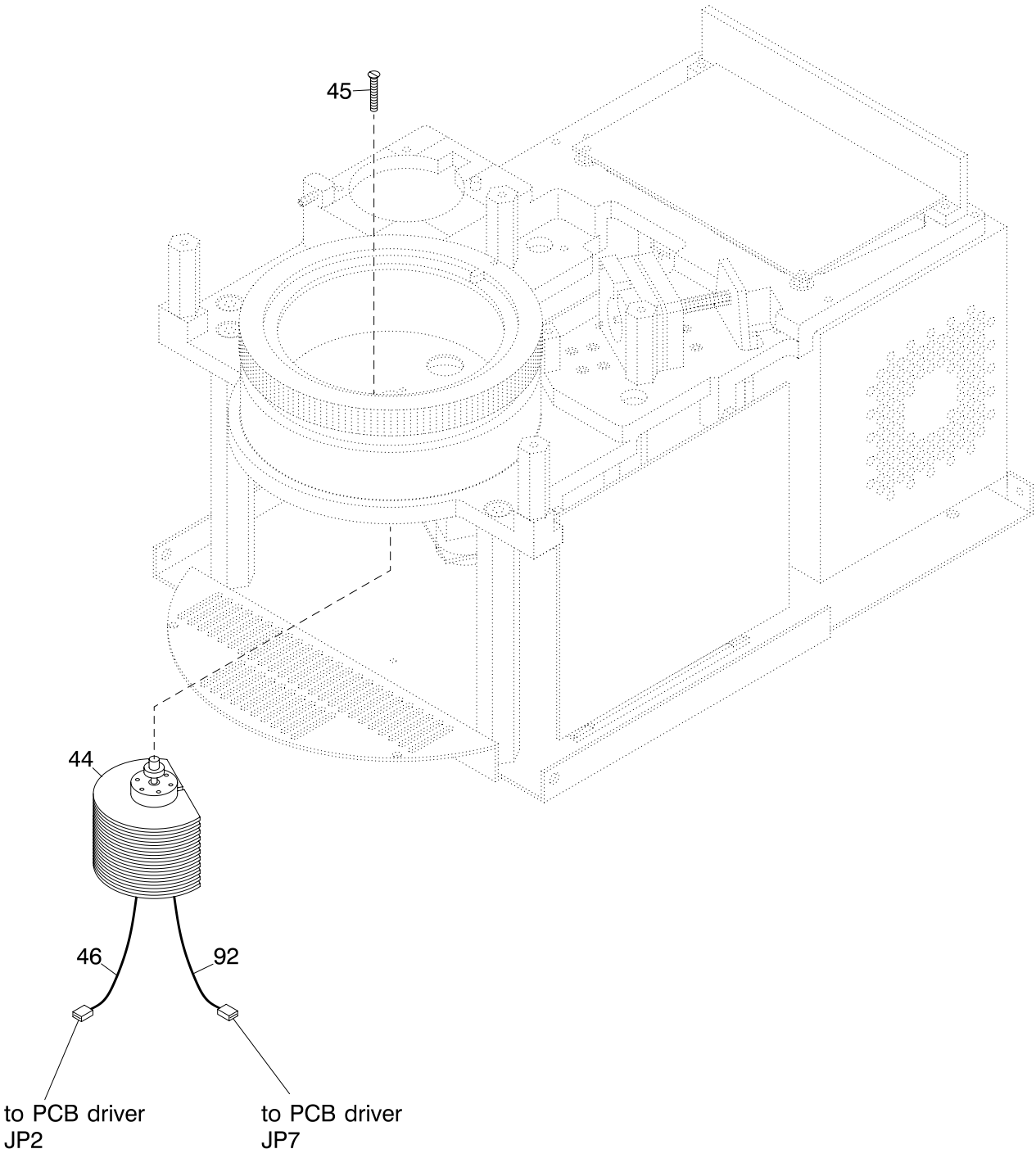



Fig. 151298k3

#### 4.6.2.2 Service Procedure

**Replaceable Components:**

- Fan motor (44)
- Screw (45) (is part of the screw set)
- Cable (46) (is part of the cable set)
- Cable (92) (is part of the cable set)

**Disassembly off the Fan Motor:**

- Disassembly of the housing parts, *see chapter 4.2*
- Disassembly of the sample rotor and fan wheel, *see chapter 4.3*
- Pull cable (46)
- Pull cable (92)
- Remove screws (45)
- Remove fan motor (44) by pulling it in a downward direction

#### 4.6.2.3 Wiring

Cable (46) and calbe (92) connects fan motor (44) to PCB driver, *see chapter 4.10.3*

#### 4.6.2.4 Adjustmemt

When assembling the heat dissipator of the fan motor (44), it is important that its edge is parallel to that of the fluorimeter.
Please ensure that the dissipator does not touch the fluorimeter.

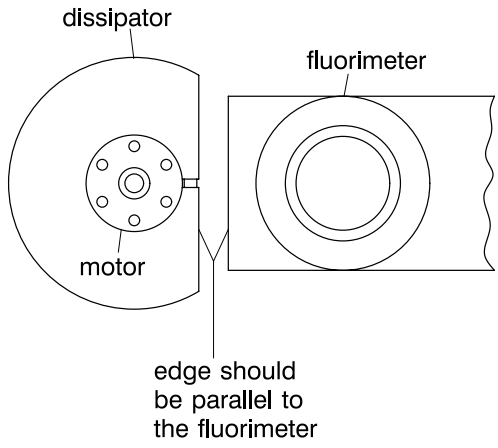



Fig. 030898k1

### 4.6.3 Measuring Chamber

#### 4.6.3.1 Location

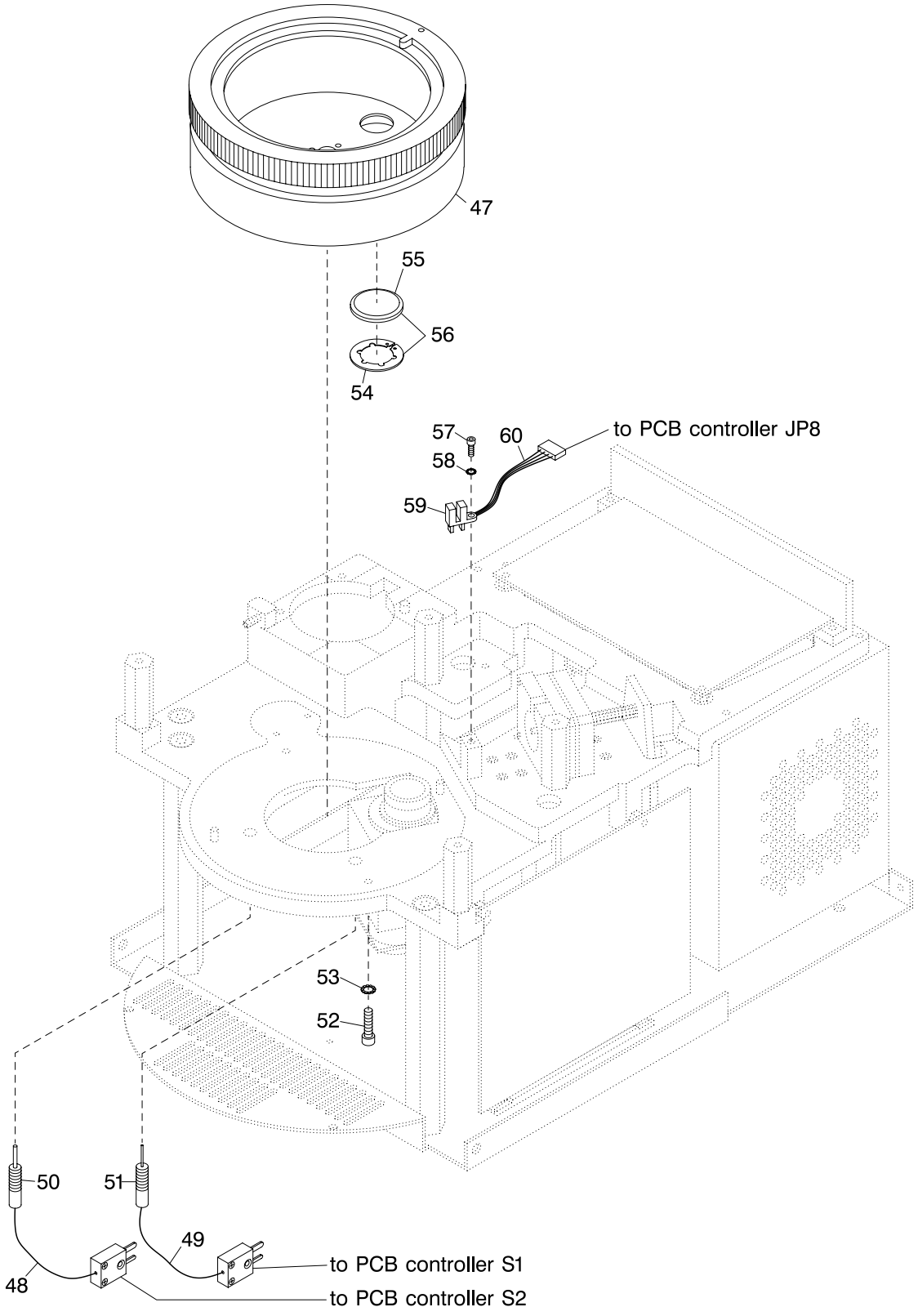



Fig. 140798k8

#### 4.6.3.2 Service Procedure

**Replaceable Components:**

- Measuring chamber (47)
- Glass window for fluorimeter (56)
- Screw (52) (is part of the screw set)
- Washer (53) (is part of the screw set)
- Cable (48) (is part of the cable set)
- Cable (49) (is part of the cable set)
- Control temp. sensor (50)
- Monitor temp. sensor (51)

**Disassembly of the Measuring Chamber and Glass Window for the Fluorimeter:**

- Disassembly of the housing parts, *see chapter 4.2*
- Disassembly of the sample rotor and fan wheel, *see chapter 4.3*
- Disassembly of the heating element, *see chapter 4.4*
- Disassembly of the chamber lid, *see chapter 4.5*
- Disassembly of the tooth belt, *see chapter 4.6.1*
- Disassembly of the fan motor, *see chapter 4.6.2*
- Pull cable (48) and cable (49)
- Unscrew control temp. sensor (50)
- Unscrew monitor temp. sensor (51)
- Remove screws (52) and washers (53)
- Lift out measuring chamber (47)
- Remove spring washer (54)
- Remove glass window (55)

**Attention:**
**Do not touch the window (55) with your fingers! A fingerprint would generate an additional flourecence signal, which would affect the measurement results! Carefully clean the window (55) with 70% ethanol, polishing it with a lint-free tissue afterwards.**

**Assembly of the Window:**
- Please use the new spring washer (54) in case of a window (55) replacement
- Ensure that the window (55) is placed in the correct position

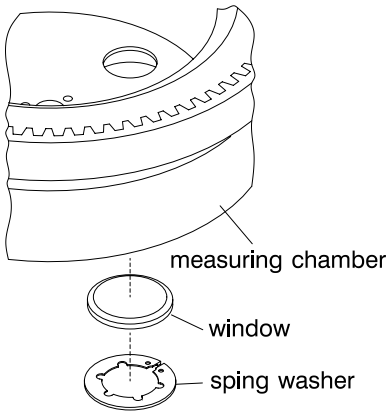



Fig. 040898k1

**Disassembly of the Rotor Lightbarrier:**

- Pull cable (60)
- Remove screws (57) and washers (58)
- Lift out rotor lightbarrier (59)

#### 4.6.3.3 Wiring

Cable (48) connects control temp. sensor (50) to PCB controller, *see 4.10.2.*
Cable (49) connects monitor temp. sensor (51) to PCB controller, *see 4.10.2.*
Cable (60) connects rotor lightbarrier (59) to PCB controller, *see 4.10.2.*

#### 4.6.3.4 Adjustment

see chapter 4.8.6.1

## 4.7 Fluorimeter Drive

The fluorimeter (65) is preadjusted by the manufacturer and is adjusted for the second time when it is assembled in the Light Cycler production plant in Germany.
In case of a defective fluorimeter, the complete instrument is to be sent to Mannheim for repairing.
Please use the RA procedure for the shipment to Mannheim, *see chapter 1.5*
The repaired instruments will be sent to you as soon as possible.

**Note:**
**Please do not touch any of the fluorimeter (65) adjustment screws (especially focus screws).**

### 4.7.1 Location

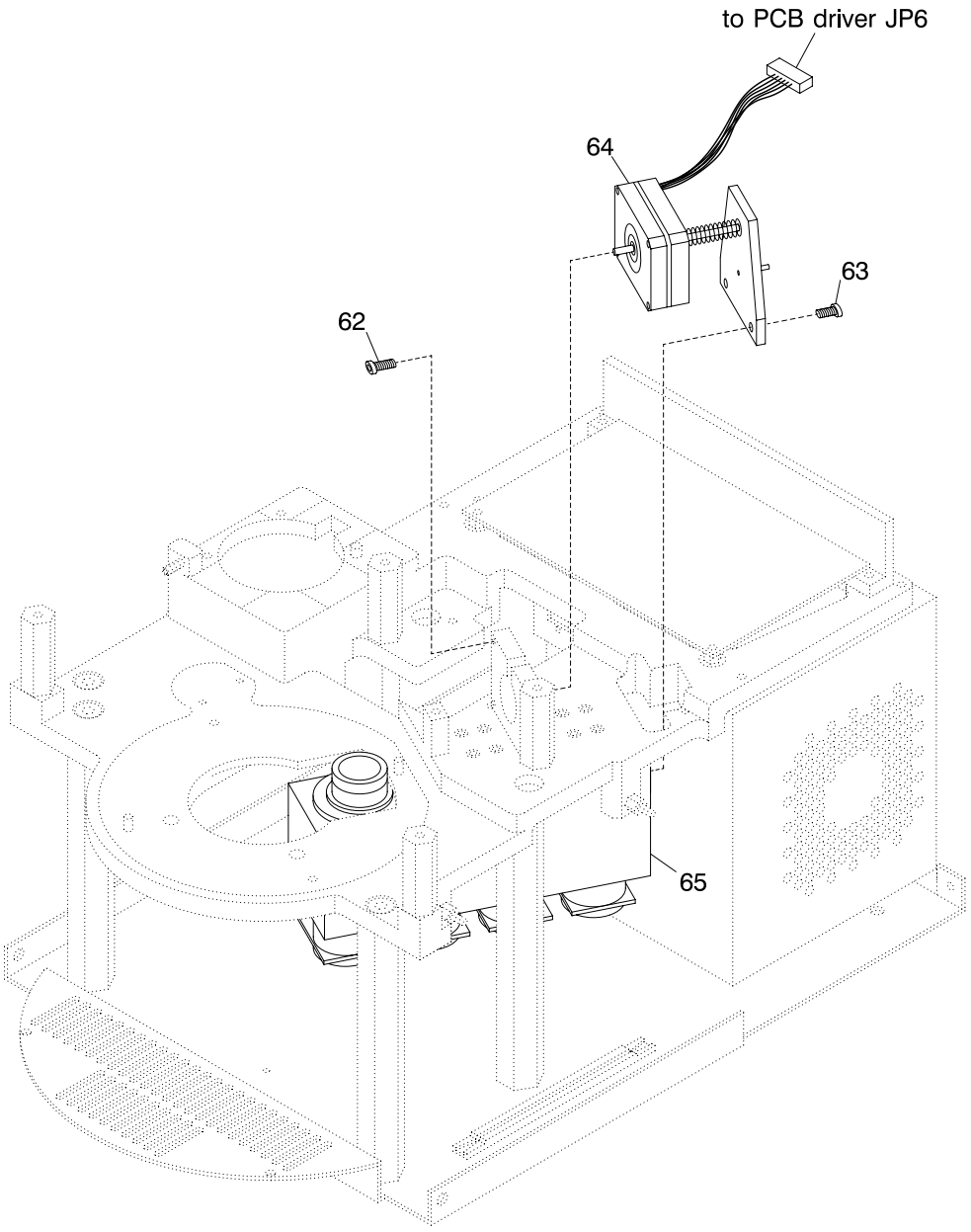



Fig. 150798k2

### 4.7.2 Service Procedures

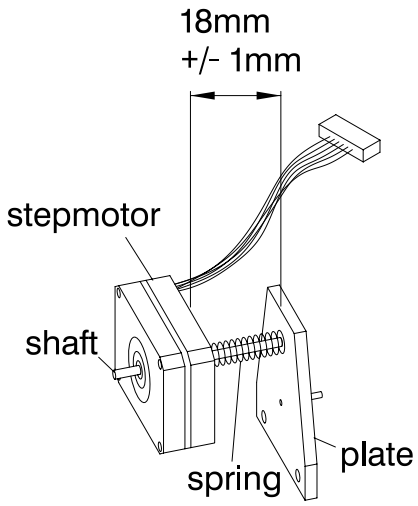
**Replaceable Components:**

- Screw (62) (is part of the screw set)
- Screw (64) (is part of the screw set)
- Fluorimeter drive (64)
- Cable (66) (is part of the cable set)

**Disassembly:**

- Pull cable (66)
- Remove screws (62) and screws (63)
- Lift out fluorimeter drive (64)

**Note:**
**If the fluorimeter drive is replaced, it is necessary to check the distance between stepper motor and the plate.**
**When assembling the photometer drive, the distance between them should be 18mm +/- 1mm.**
**If an adjustment is necessary, turn the plate until the required distance is reached.**




### 4.7.3 Wiring

Cable (66) connects fluorimeter drive (64) to PCB driver, *see 4.10.3.*

## 4.8 Lightbarriers and Sensors

### 4.8.1 Location

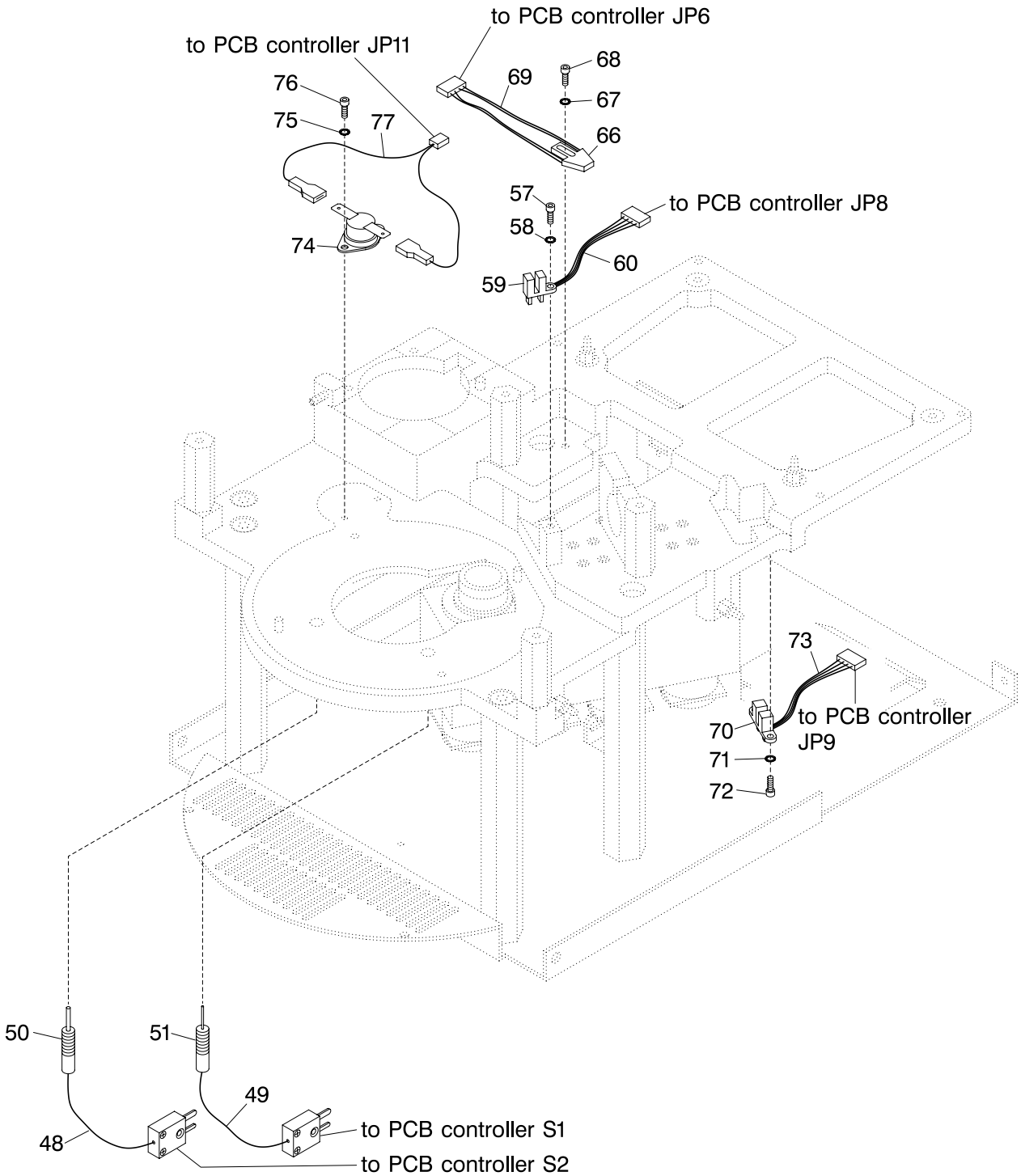



Fig. 150798k3

### 4.8.2 Rotor Lightbarrier

The rotor lightbarrier monitirs the rotations of the rotor.

**Replaceable Components:**

- Rotor lightbarrier (59)
- Screw (57) (is part of the screw set)
- Washer (58) (is part of the screw set)
- Cable (60) (is part of the cable set)

**Disassembly:**

- Disassembly of the housing parts, *see chapter 4.2*
- Disassembly of the sample rotor and fan wheel, *see chapter 4.3*
- Disassembly of the heating element, *see chapter 4.4*
- Disassembly of the chamber lid, *see chapter 4.5*
- Disassembly of the tooth belt, *see chapter 4.6.1*
- Pull cable (60)
- Remove screw (57) and washer (58)
- Lift out rotor lightbarrier (59)

#### 4.8.2.1 Wiring

Cable (60) connects rotor lightbarrier (59) to PCB controller, *see chapter 4.10.2*

### 4.8.3 Interlock Lightbarrier

The interlock lightbarrier is a reflection lightbarrier. It senses whether the housing lid is open or closed.

**Replaceable Components:**

- Interlock lightbarrier (66)
- Screw (68) (is part of the screw set)
- Washer (67) (is part of the screw set)
- Cable (69) (is part of the cable set)

**Disassembly:**

- Disassembly of the housing, *see chapter 4.2.2*
- Pull cable (69)
- Remove screw (68) and washer (67)
- Lift out interlock lightbarrier (66)

#### 4.8.3.1 Wiring

Cable (66) connects interlock lightbarrier (66) to PCB controller, *see chapter 4.10.2*

### 4.8.4 Fluorimeter Lightbarrier

The fluorimeter lightbarrier monitirs the fluorimeter movements.

**Replaceable Components:**

- Fluorimeter lightbarrier (70)
- Screw (72) (is part of the cable set)
- Washer (71) (is part of the screw set)
- Cable (73) (is part of the cable set)

**Disassembly:**

- Disassembly of the housing, *see chapter 4.2.2*
- Pull cable (73)
- Remove screw (72) and washer (71)
- Lift out fluorimeter lightbarrier (70)

#### 4.8.4.1 Wiring

Cable (73) connects fluorimeter lightbarrier (70) to PCB controller, *see chapter 4.10.2*

### 4.8.5 Monitor Temperature Sensor

The monitor temperature sensor monitors the measuring chamber temperature and prevents excess temperature.

**Replaceable Components:**

- Monitor temperature sensor (51)
- Cable (49) (is part of the cable set)

**Disassembly:**

- Disassembly of the panel, *see chapter 4.2.3*
- Pull cable (49)
- Unscrew monitor temperature sensor (51)

#### 4.8.5.1 Adjustment

see chapter 4.8.6.1

#### 4.8.5.2 Wiring

Cable (49) connects monitor temperature sensor (51) to PCB controller, *see chapter 4.10.2.*

### 4.8.6 Control Temperature Sensor

The control temperature sensor controls excess temperature in the measuring chamber.

**Replaceable Components:**

- Control temperature sensor (50)
- Cable (48) (is part of the cable set)

**Disassembly:**

- Disassembly of the panel, *see chapter 4.2.3*
- Pull cable (48)
- Unscrew control temperature sensor (50)

#### 4.8.6.1 Adjustment

**Temperature Sensors**

Two temperature sensors for temperature control and temperature monitoring are located in the measuring chamber of the light cycler. The sensors should be placed close to the capillaries in the sample rotor so that the temperature can be monitored as accurately as possible. However, the sensors must not touch the capillaries when the rotor is moving.
For this reason, the height of these sensors needs to be adjusted.

See drawing below:

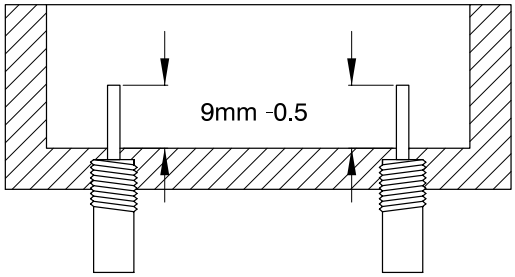



Fig. 030898k1

The height can be adjusted by turning the sensor fixation screws clockwise or counterclockwise.

#### 4.8.6.2 Wiring

Cable (48) connects control temperature sensor (50) to PCB controller, *see chapter 4.10.2.*

### 4.8.7 Excess Temperature Switch

The excess temperature switch is a bimetal switch which protects the Light Cycler from overheating, e.g due to excess periods of operation.

**Replaceable Components:**

- Excess temperature switch (74)
- Screw (76) (is part of the screw set)
- Washer (75) (is part of the screw set)
- Cable (77) (is part of the cable set)

**Disassembly:**

- Disassembly of the housing, *see chapter 4.2.2*
- Pull cable (77)
- Remove screw (76) and washer (75)
- Lift out excess temperature switch (74)

#### 4.8.7.1 Wiring

Cable (77) connects excess temperature switch (74) to PCB controller, *see chapter 4.10.2*

## 4.9 Power Supply

### 4.9.1 Location

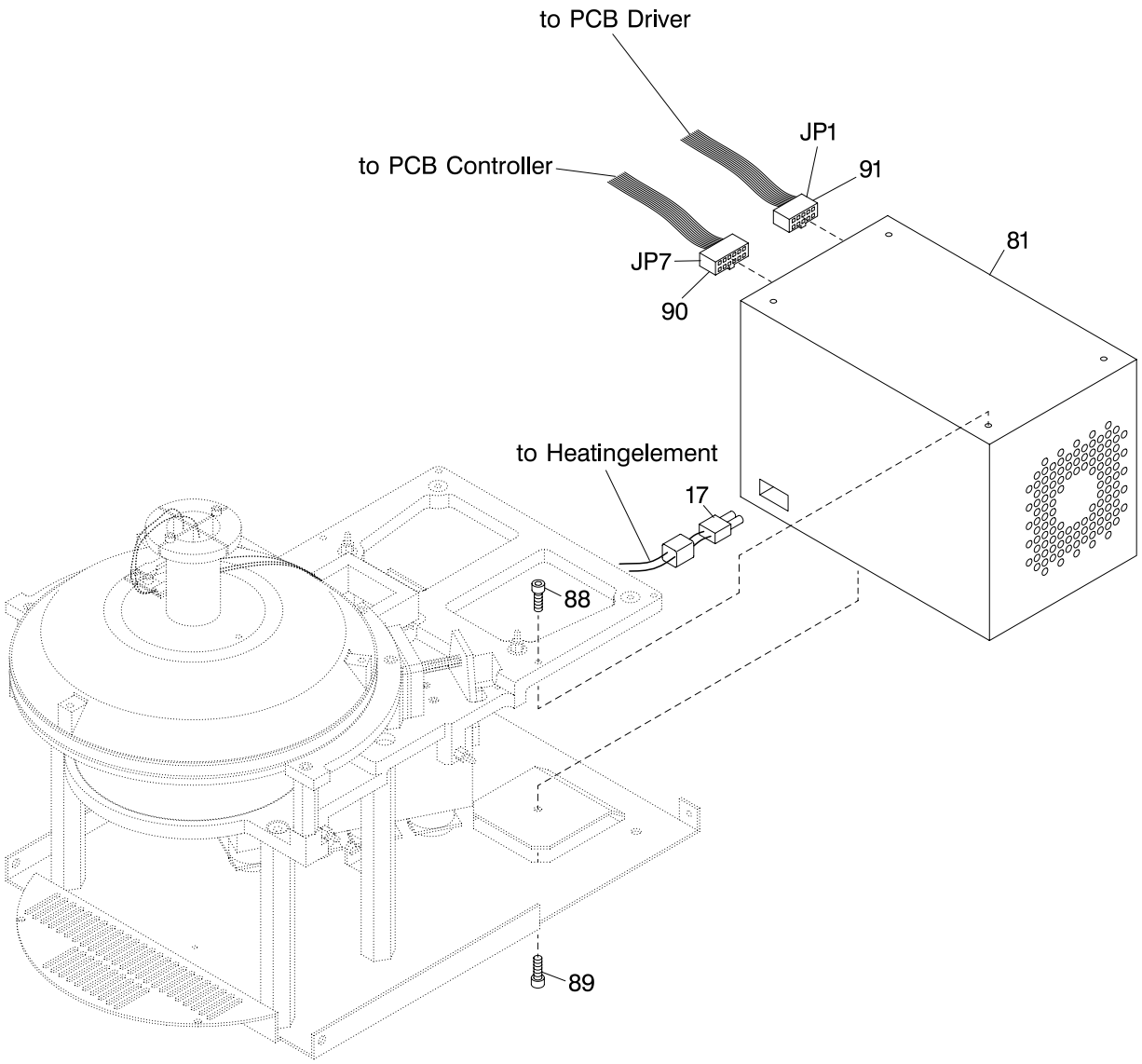



Fig. 230998k1

### 4.9.2 Service Procedure

**Replaceable Components:**

- Power supply (81)
- Cable (17) (is part of the cable set)
- Cable (90) (is part of the cable set)
- Cable (91) (is part of the cable set)
- Screw (88) (is part of the screw set)
- Screw (89) (is part of the screw set)

**Disassembly of the Power Supply:**

- Disassembly of the housing parts, *see chapter 4.2*
- Pull cable (17)
- Pull cable (90)
- Pull cable (91)
- Remove screws (88)
- Remove screw (89)
- Pull out the power supply (81)

### 4.9.3 Wiring

Cable (17) connects power supply (81) to heating element, *see chapter 4.4.*

Cable (90) connects power supply (81) to PCB controller, *see chapter 4.10.2.*

Cable (91) connects power supply (81) to PCB driver, *see chapter 4.10.23*

## 4.10 PCBs

### 4.10.1 Location

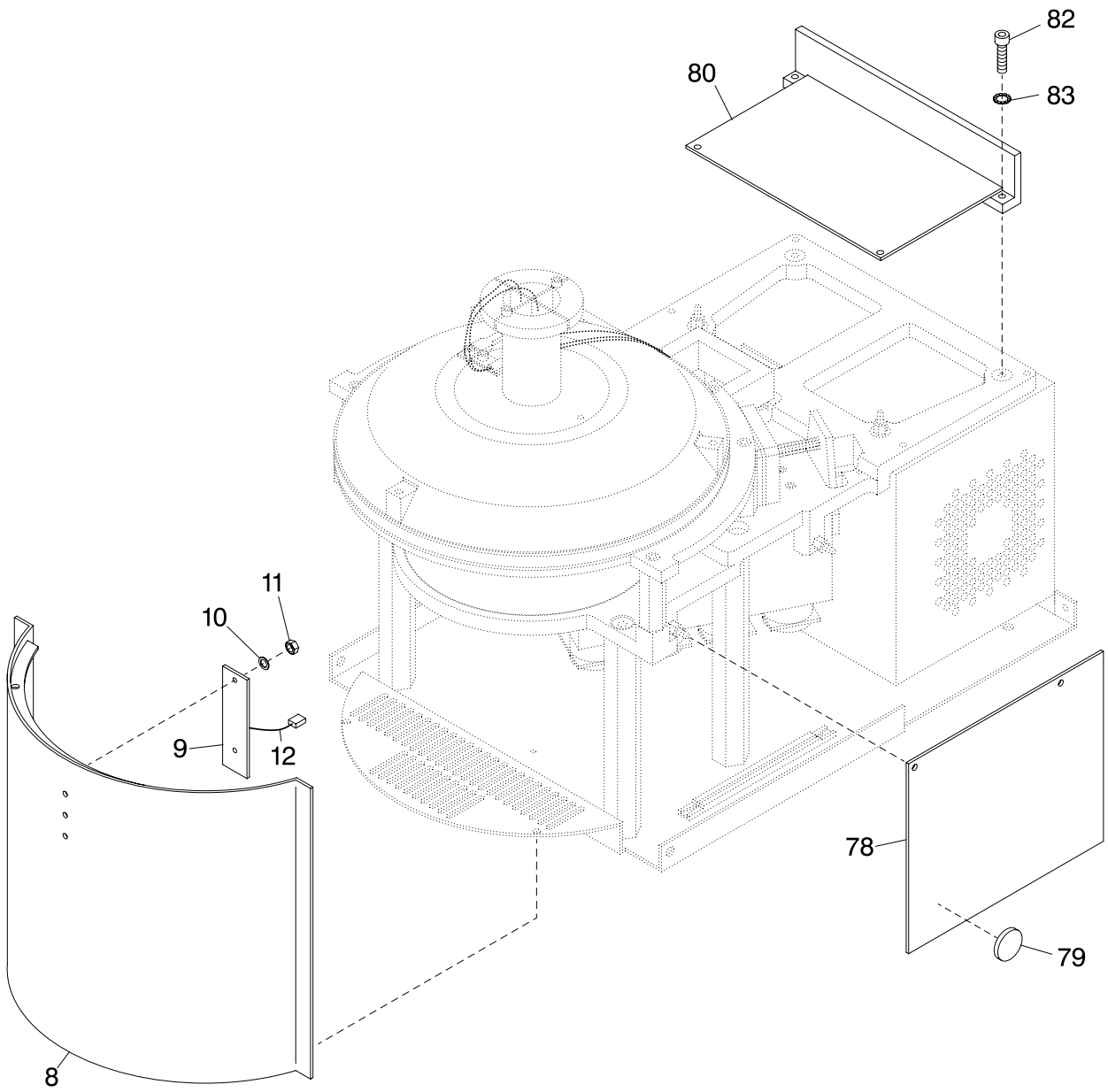



Fig. 100898k1

### 4.10.2 PCB Controller und Battery

The PCB controller of the Light Cycler houses the essential control functions, data recording and communication with the PC via interface RS232.

**Replaceable Components:**

- PCB controller (78)
- Battery (79)

**Disassembly of the PCB Controller:**

- Disassembly of the housing,
  *see chapter 4.2.2*
- Pull all the connecting cables from the PCB controller (78)
- Remove the PCB controller (78) located on the side

**Disassembly of the Battery:**

- Disassembly of the housing,
  *see chapter 4.2.2*
- Remove battery (79) from the PCB controller (78)

#### 4.10.2.1 Wiring

Aufzählung der Kabel, die zum PCB Controller gehen!

### 4.10.3 PCB Driver

was macht dieses?

**Replaceable Components:**

- PCB Driver (80)
- Screws (82) (are part of the screw set)
- Washers (83) (are part of the screw set)

**Disassembly:**

- Disassembly of the housing,
  see chapter 4.2.2
- Pull all the connecting cables from the PCB driver (80)
- Remove screws (82) and washers (82)
- Lift out PCB driver (80)

#### 4.10.3.1Wiring

Aufzählung der Kabel, die zum PCB Controller gehen!

### 4.10.4 Status Board

was macht dieses?

**Disassembly:**

- Disassembly of the panel (8)
  *see chapter 4.2.3*
- Remove nuts (11) with washers (10)
- Remove status board (9)
- Pull cable (12)

#### 4.10.4.1 Wiring

Cable (12) connects status board (9) to PCB controller JP12, *see chapter 4.10.2*

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# 5 Electronics

## 5.1 Overview

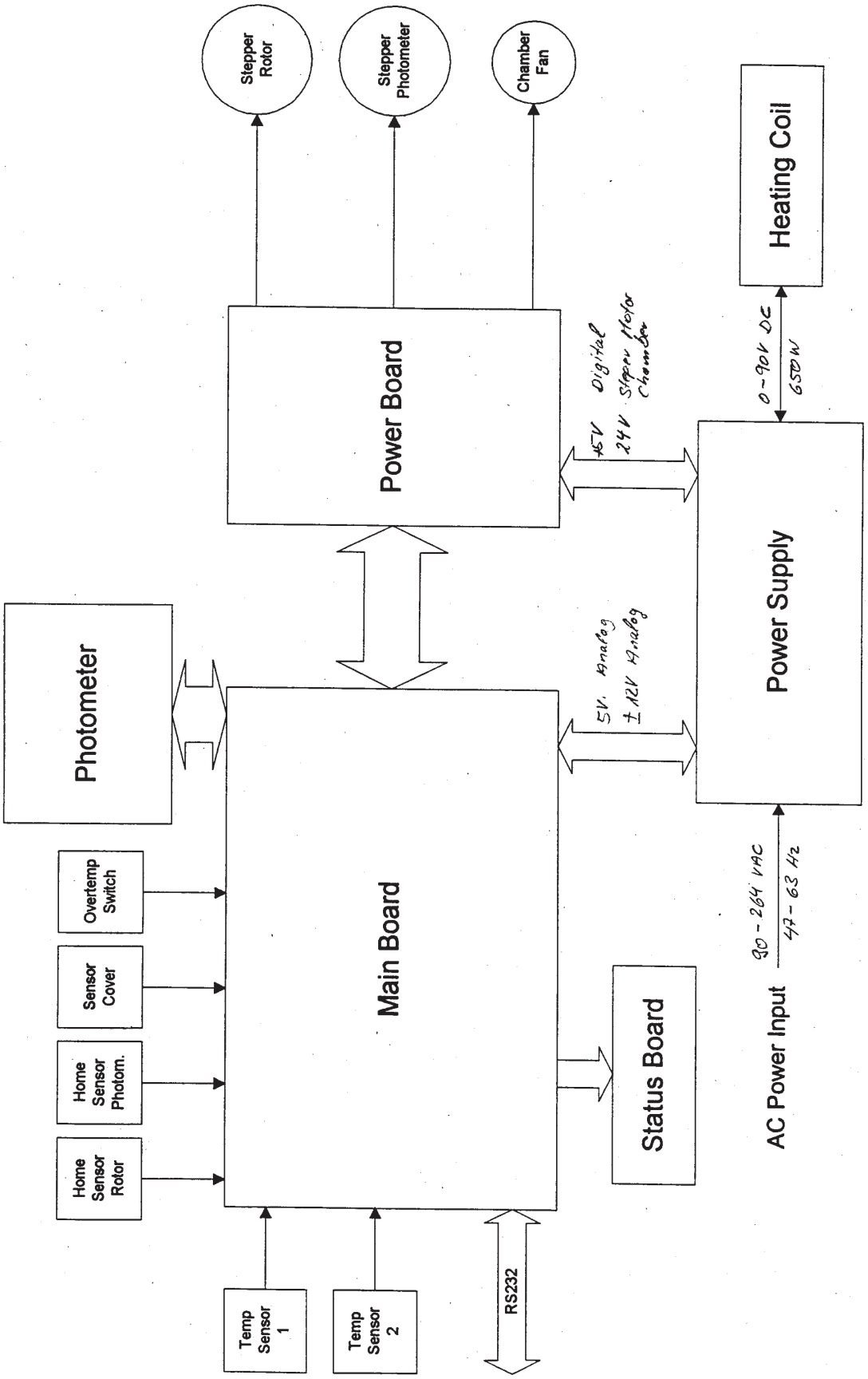


Fig. 5-2

## 5.2 Cable Connections

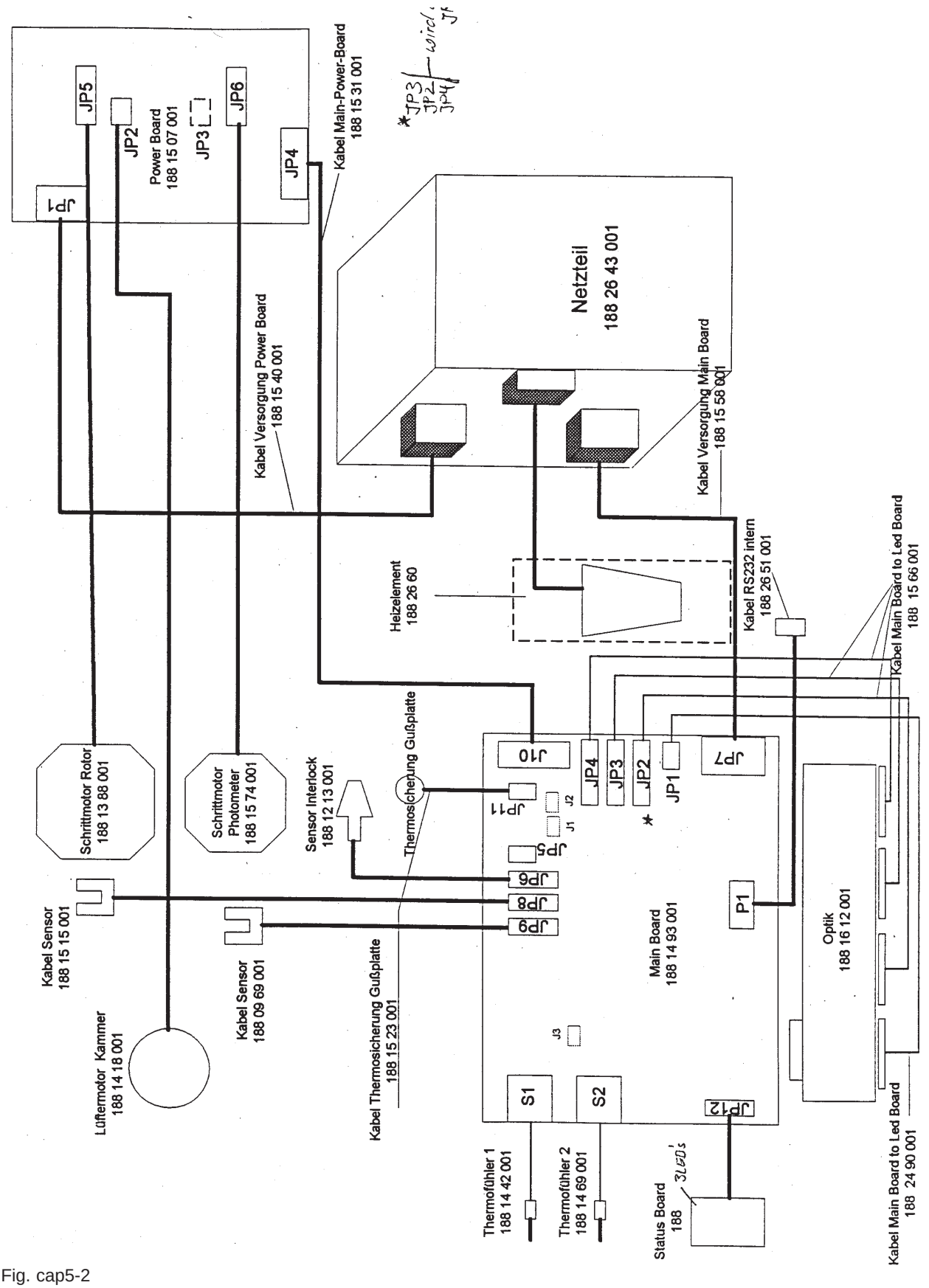


Fig. cap5-2

## 5.3 PCB Controller

### 5.3.1 Location

**Functional Description of the PCB Controller of the LightCycler**

The PCB controller of the Light Cycler houses the essential control functions, data recording and communication with the PC via RS232.

These functions are:

- Interface RS232, galvanically isolated via optocoupler, serves for communication with the PC.
- Interface management between PC and temp. and/or step processor by means of a PIC processor
- 2 microprocessors (temp. processor and step processor) for temperature regulation, positioning of the stepper motors and recording of the measuring values
- 2 temperature measuring channels:
  - Channel 1 for regulating the chamber temperature by means of the temp. processor, indication of the actual temperature in the measuring chamber and control of excess temperature.
  - Channel 2 for control of excess temperature
- EEPROM for storing the device-specific calibration data and various parameters as well as the serial numbers of the instrument and the fluorimeter
- Digital-to-analog converter and driver for regulating the LED current for the blue fluorimeter LED
- 12 bit analog-to-digital converter for converting the voltage analog to the temperature for temperture regulation by means of the temp. processor
- Multi-channel 12 bit analog-to-digital converter for converting the measuring values of the 3 fluorimeter channels and the temperature for the display
- Data interface with the power supply for transferring the actual set values for the heating voltage (this serial interface is also galvanically isolated from the power supply via optocoupler)

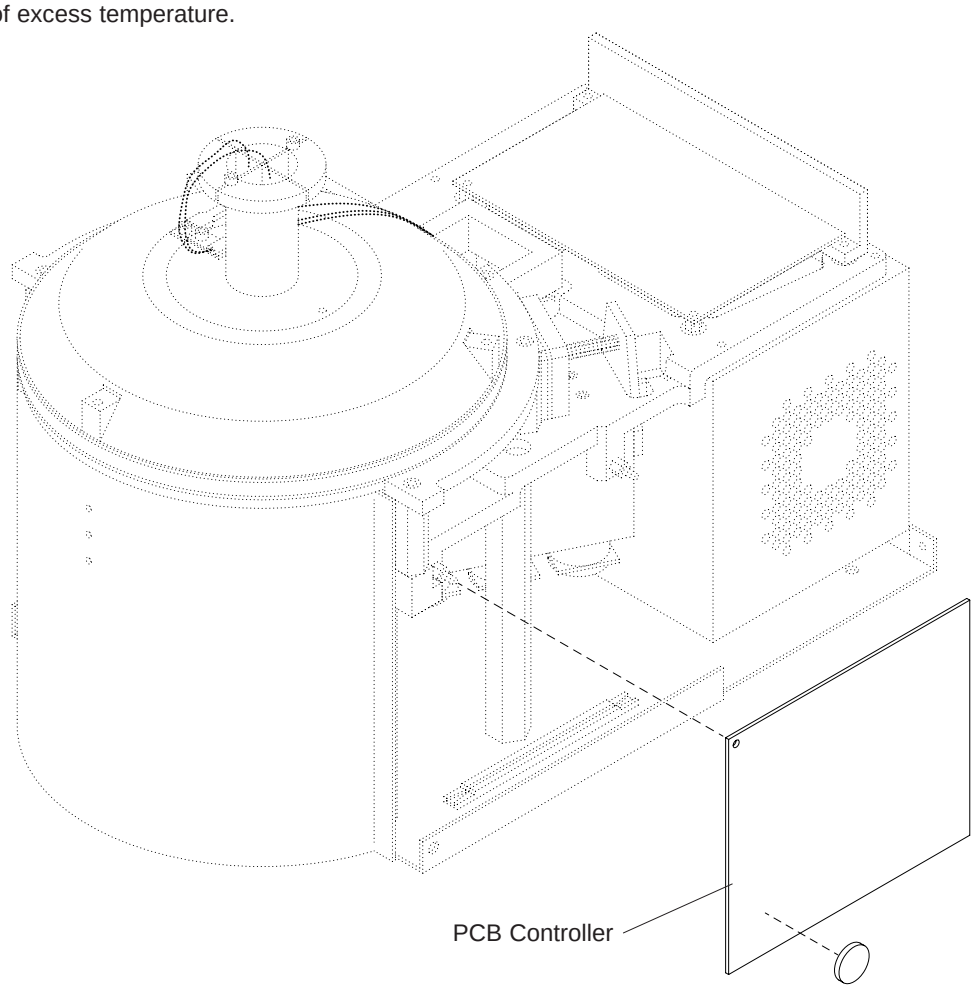


Fig. 221298k1

### 5.3.2 Block Diagram PCB Controller

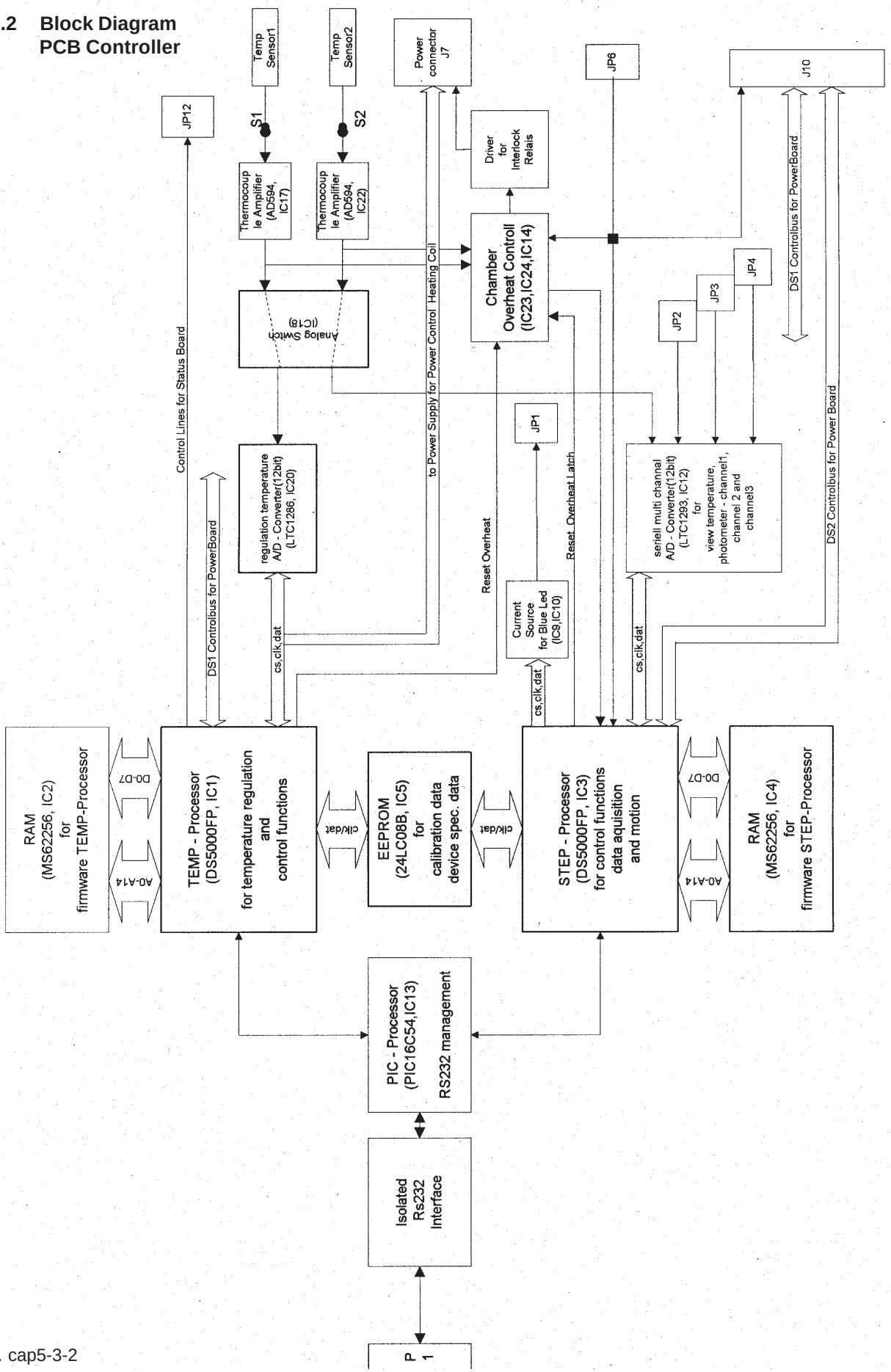
Temp Sensor1
Temp Sensor2
Power connector J7
JP6
J10
JP12
S1
S2
Driver for Interlock Relais
Thermocouple Amplifier (AD594, IC17)
Thermocouple Amplifier (AD594, IC22)
Chamber Overheat Controll (IC23,IC24,IC14)
DS1 Controlbus for PowerBoard
JP2
JP3
JP4
Analog Switch (IC18)
Control Lines for Status Board
to Power Supply for Power Control Heating Coil
JP1
regulation temperature A/D - Converter(12bit) (LTC1286, IC20)
seriell multi channal A/D - Converter(12bit) (LTC1293, IC12) for view temperature, photometer - channel1, channel 2 and channel3
Reset Overheat
Reset Overheat Latch
DS2 Controlbus for Power Board
Current Source for Blue Led (IC9,IC10)
cs,clk,dat
RAM (MS62256, IC2) for firmware TEMP-Processor
D0-D7
A0-A14
TEMP - Processor (DS5000FP, IC1) for temperature regulation and control functions
clk/dat
EEPROM (24LC08B, IC5) for calibration data device spec. data
STEP - Processor (DS5000FP, IC3) for control functions data aquisition and motion
RAM (MS62256, IC4) for firmware STEP-Processor
PIC - Processor (PIC16C54,IC13) RS232 management
Isolated Rs232 Interface
P 1

Fig. cap5-3-2

### 5.3.3 Printed Circuit Diagram PCB Controller

Page 1 of 4

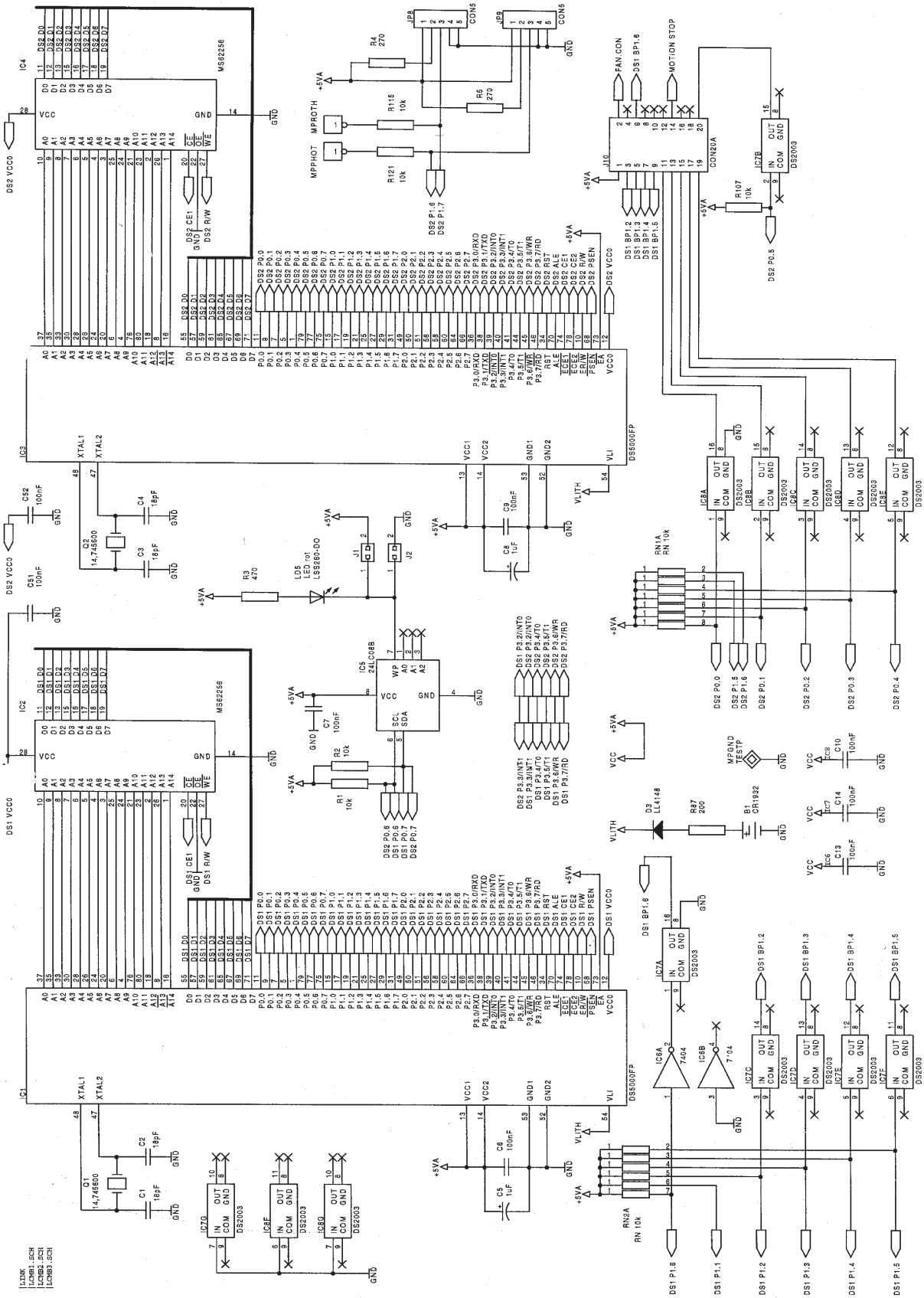

Fig. main-a

### 5.3.3 Printed Circuit Diagram PCB Controller

Page 2 of 4

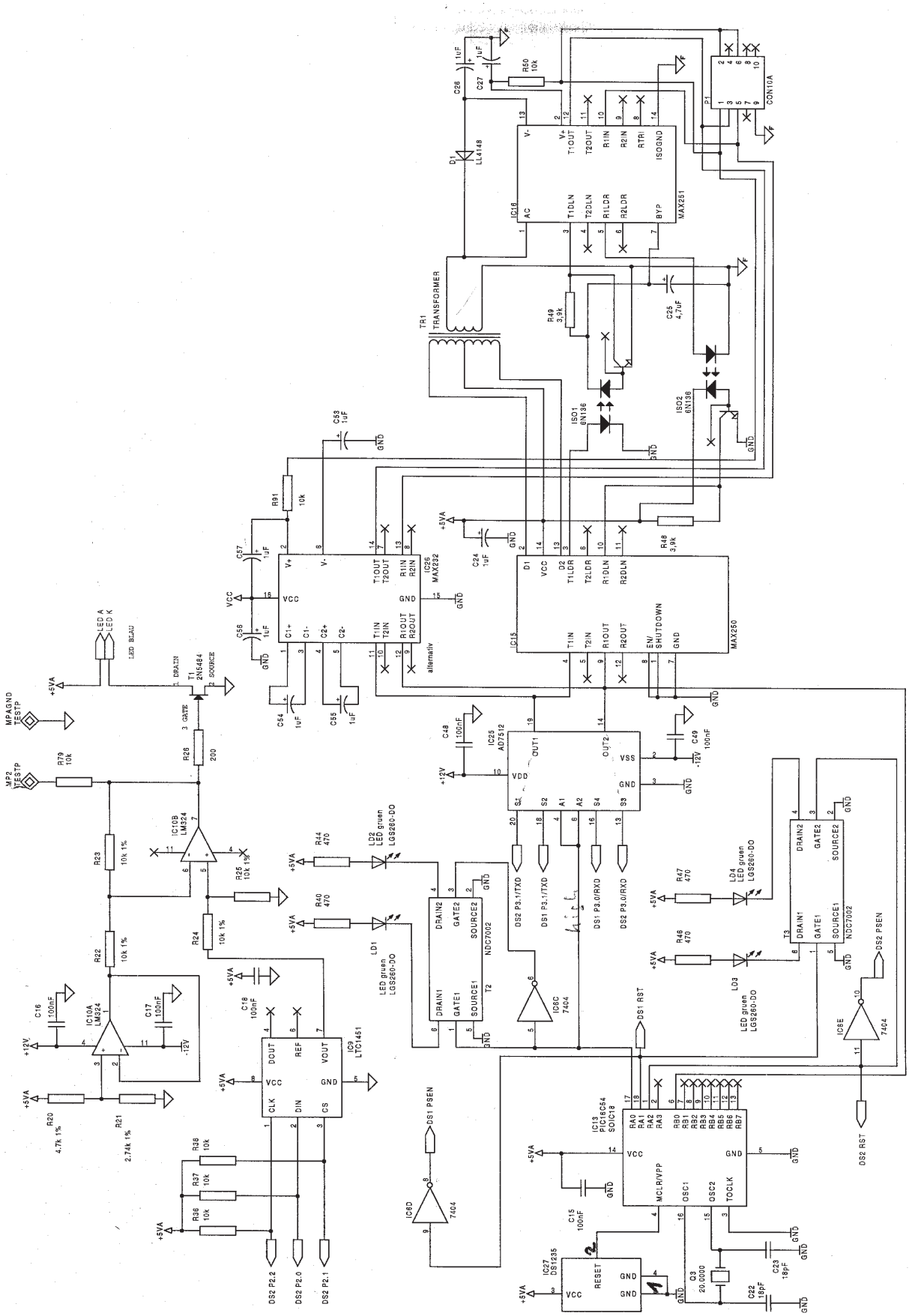

Fig. main-c

### 5.3.3 Printed Circuit Diagram PCB Controller

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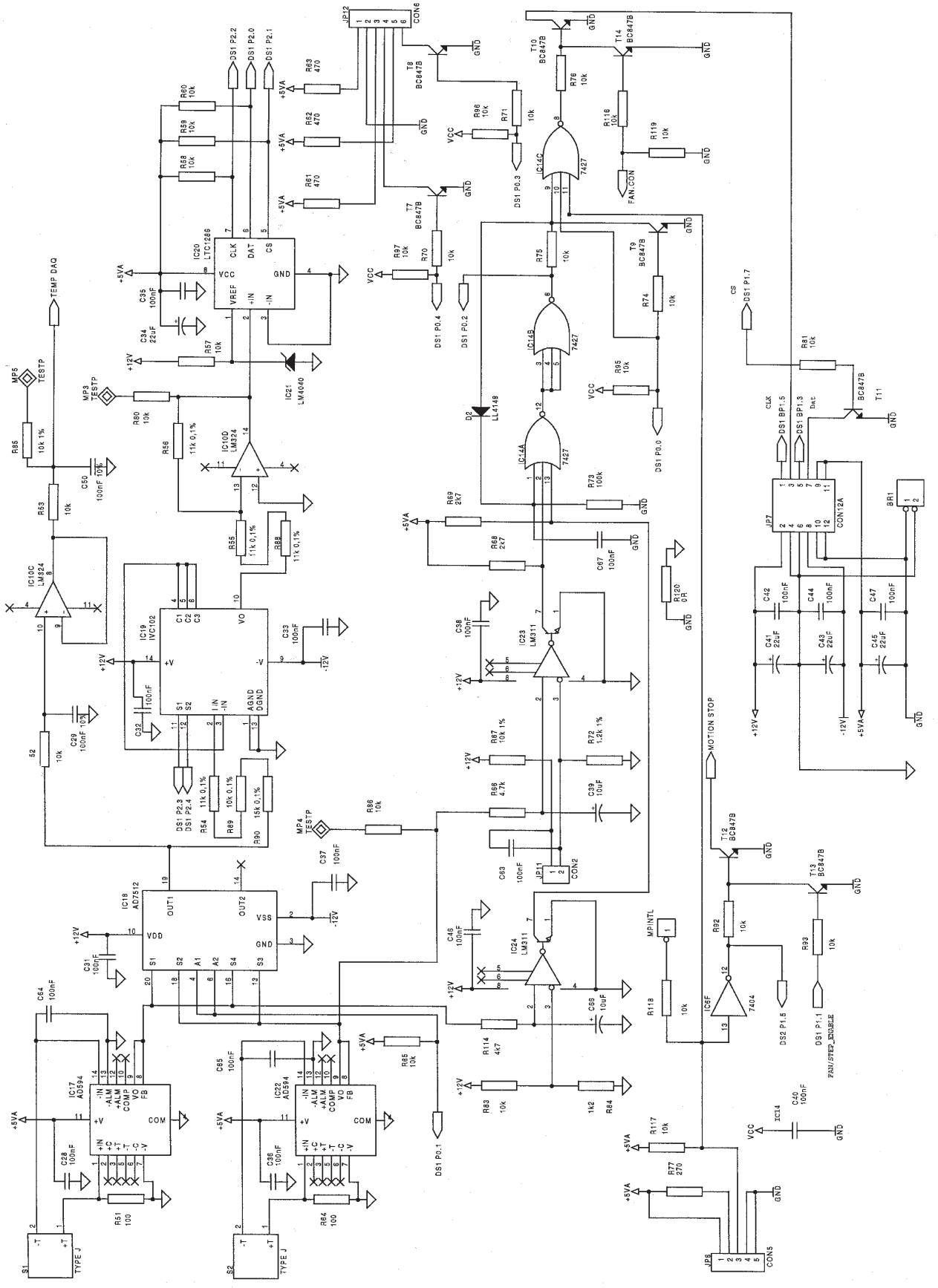

Fig. main-b

### 5.3.3 Printed Circuit Diagram PCB Controller

Page 4 of 4

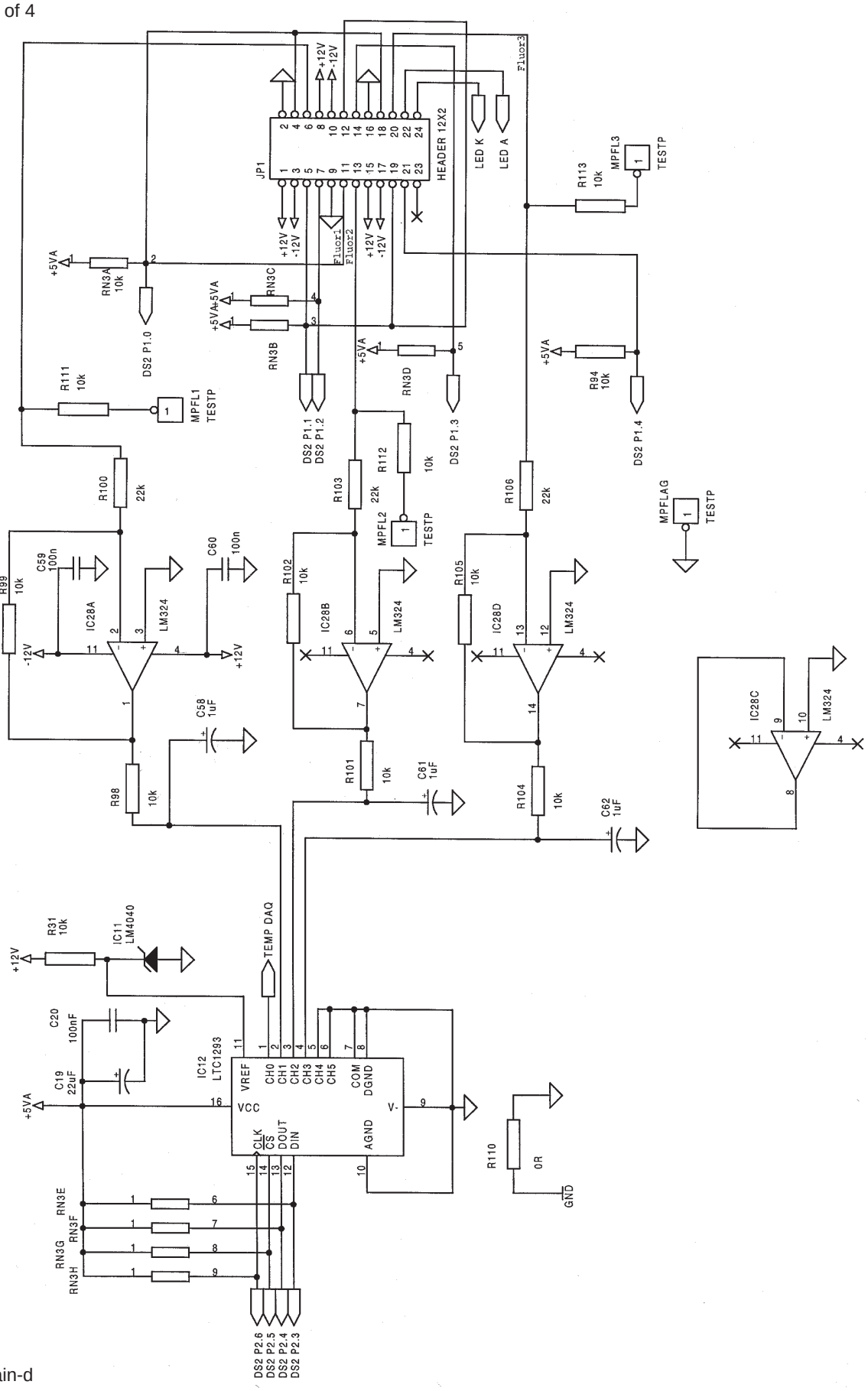


Fig. main-d

### 5.3.4 Layout Diagram PCB Controller

Page 1 of 2

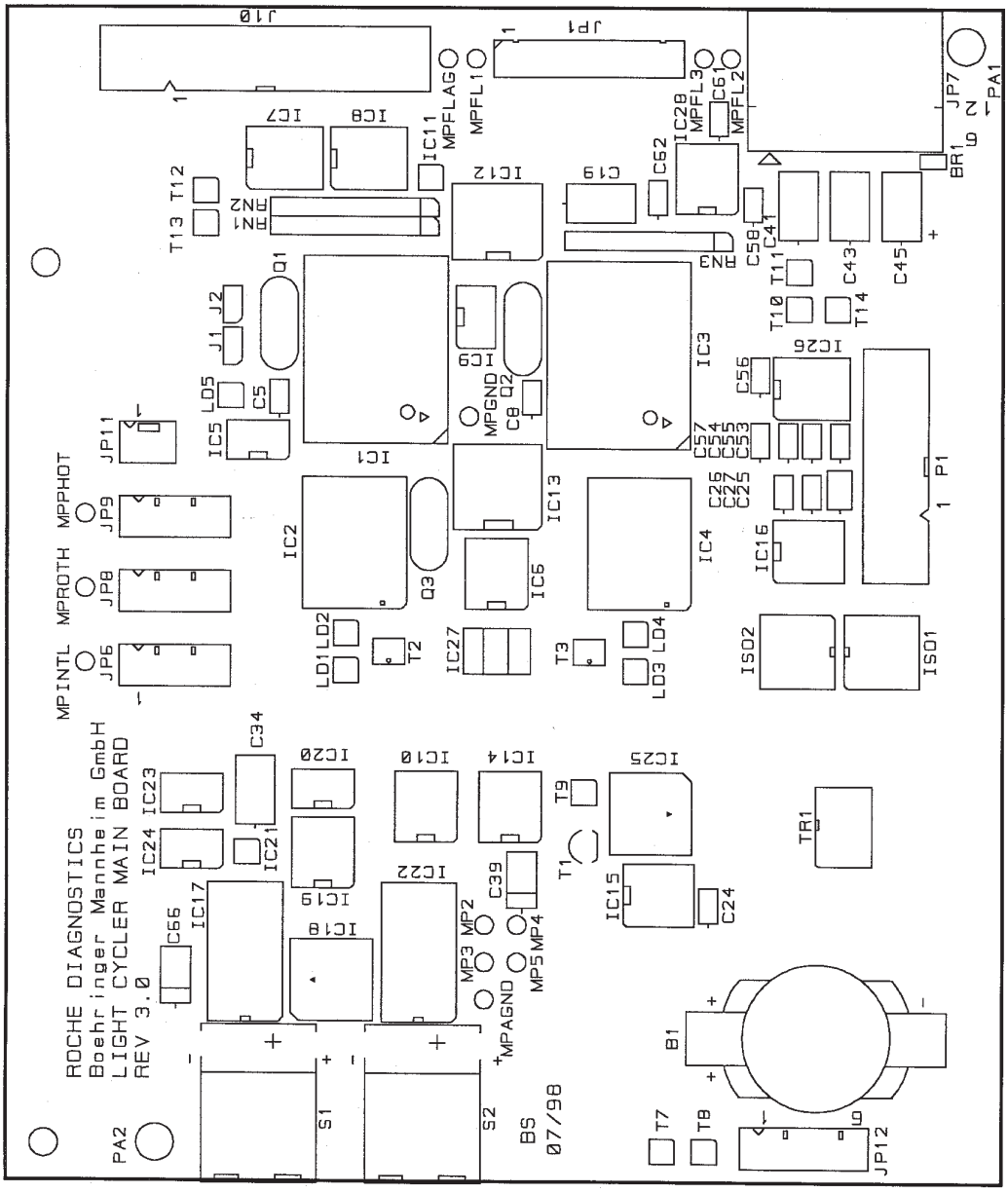


Fig. main-e

### 5.3.4 Layout Diagram PCB Controller

Page 2 of 2

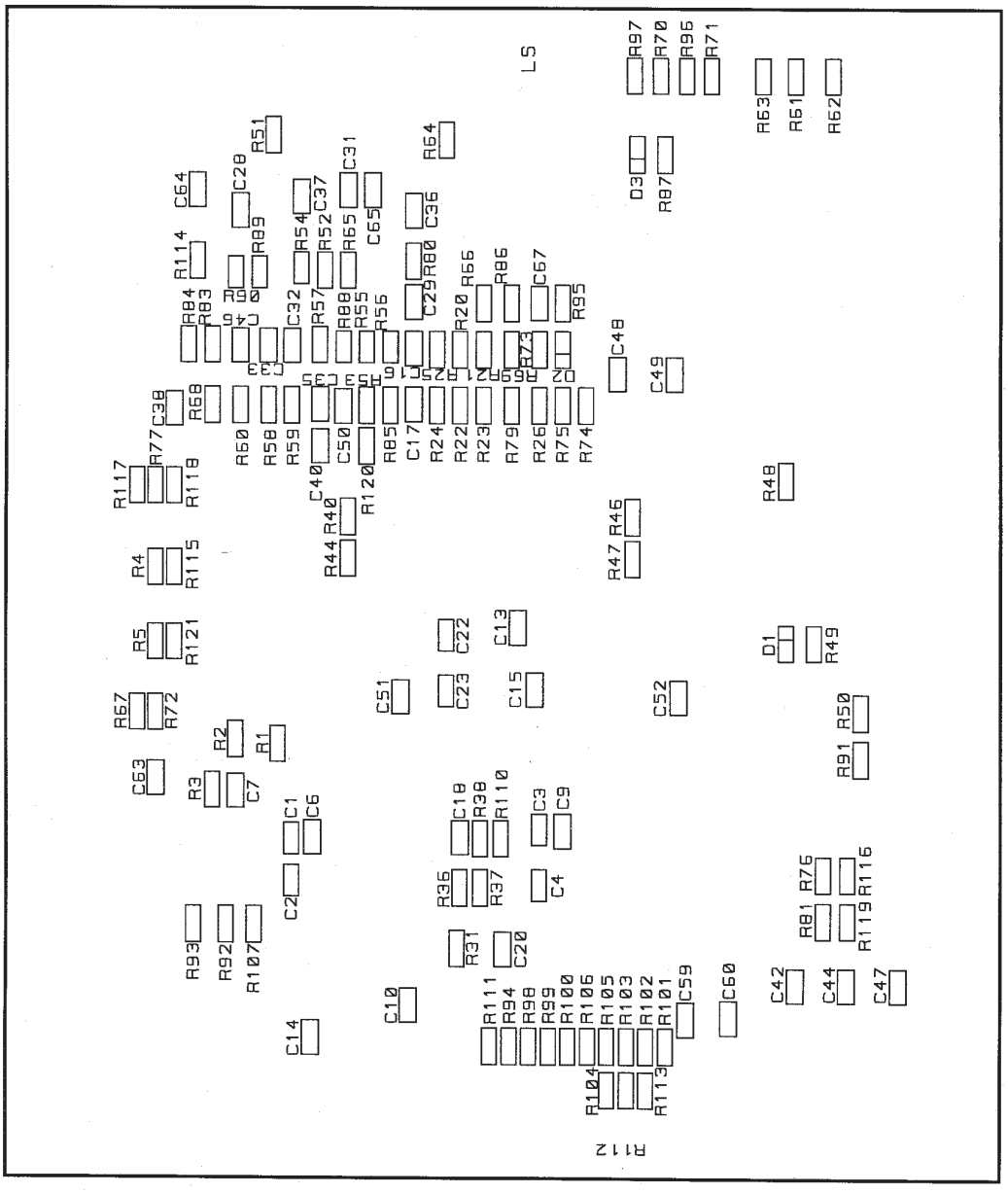


Fig. main-f

## 5.4 PCB Driver

### 5.4.1 Location

**Functional Description of the LightCycler Power Board**

The LightCycler power board houses the following functions:

- Driver for the stepper motor of the rotor
- Driver for the linear stepper motor of the fluorimeter drive
- Linear controller for driving the chamber fan, setting the actual setpoint value by means of a serial 12 bit digital-to-analog converter
- The speed of the chamber fan which is equipped with an encoder is controlled by means of a frequency converter and one comparator each for minimum and maximum speed (releasing or blocking of the heating voltage depends on this)

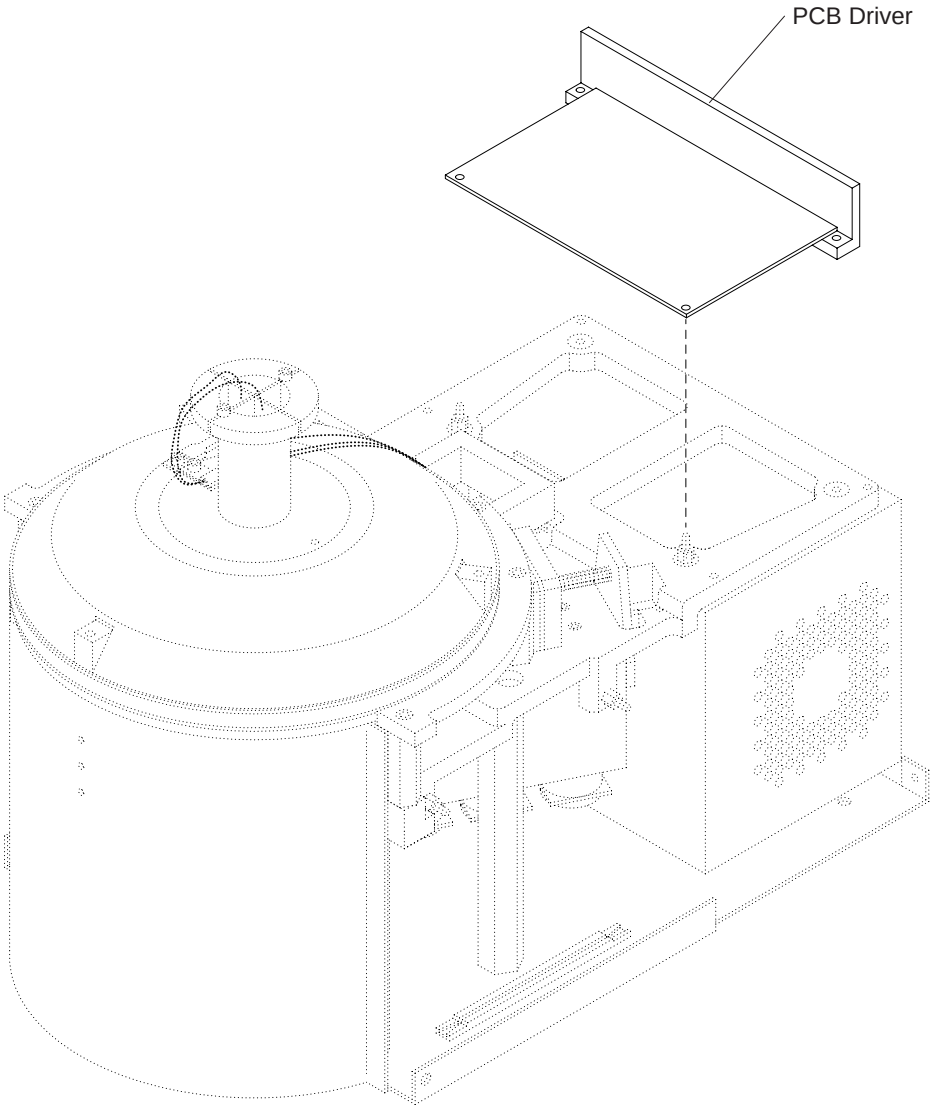


Fig. 221298k2

### 5.4.2 Block Diagram PCB Driver

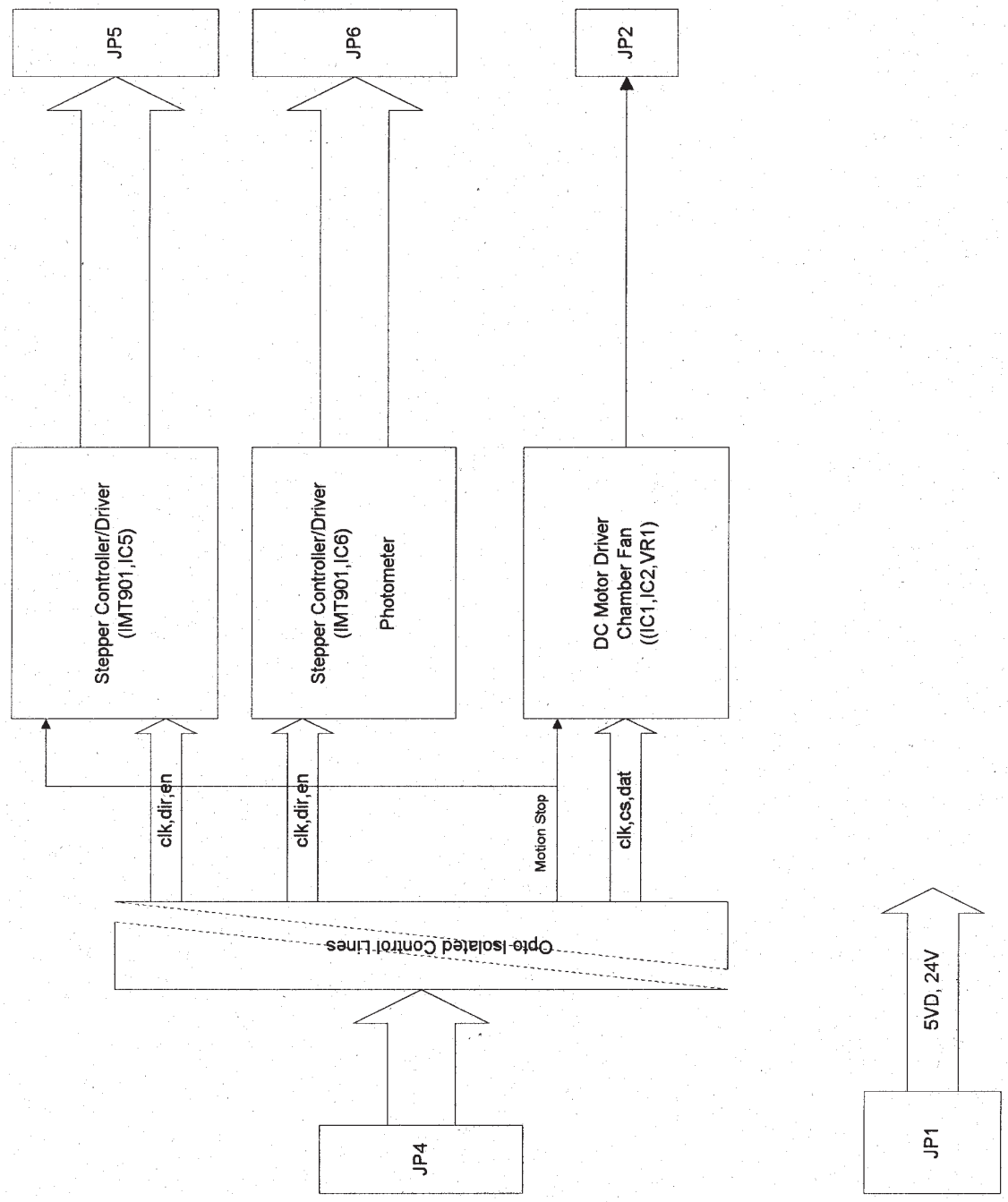


Fig. cap5-4-2

### 5.4.3 Printed Circuit Diagram PCB Driver

Page 1 of 3

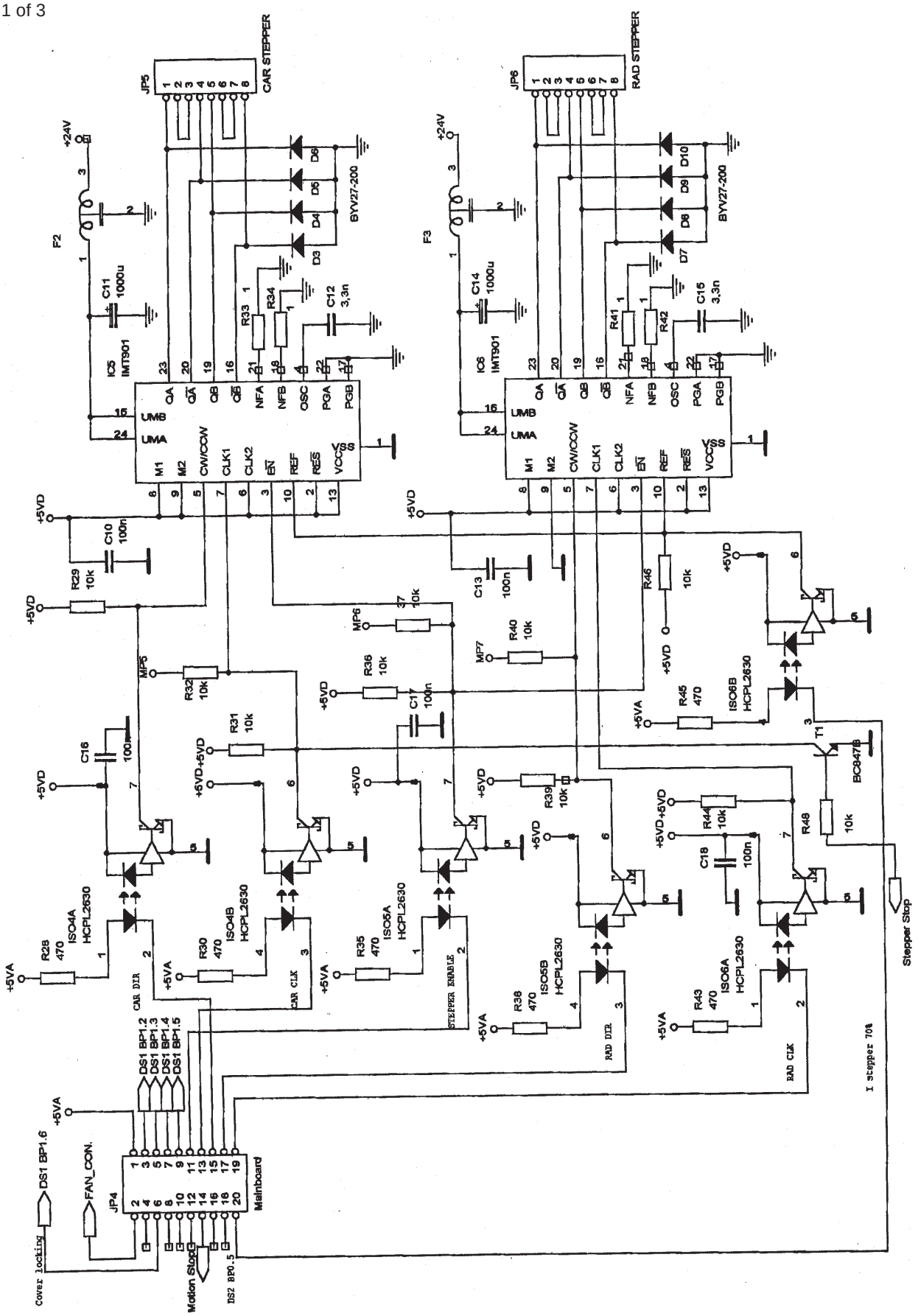


Fig. power-a

### 5.4.3 Printed Circuit Diagram PCB Driver

Page 2 of 3

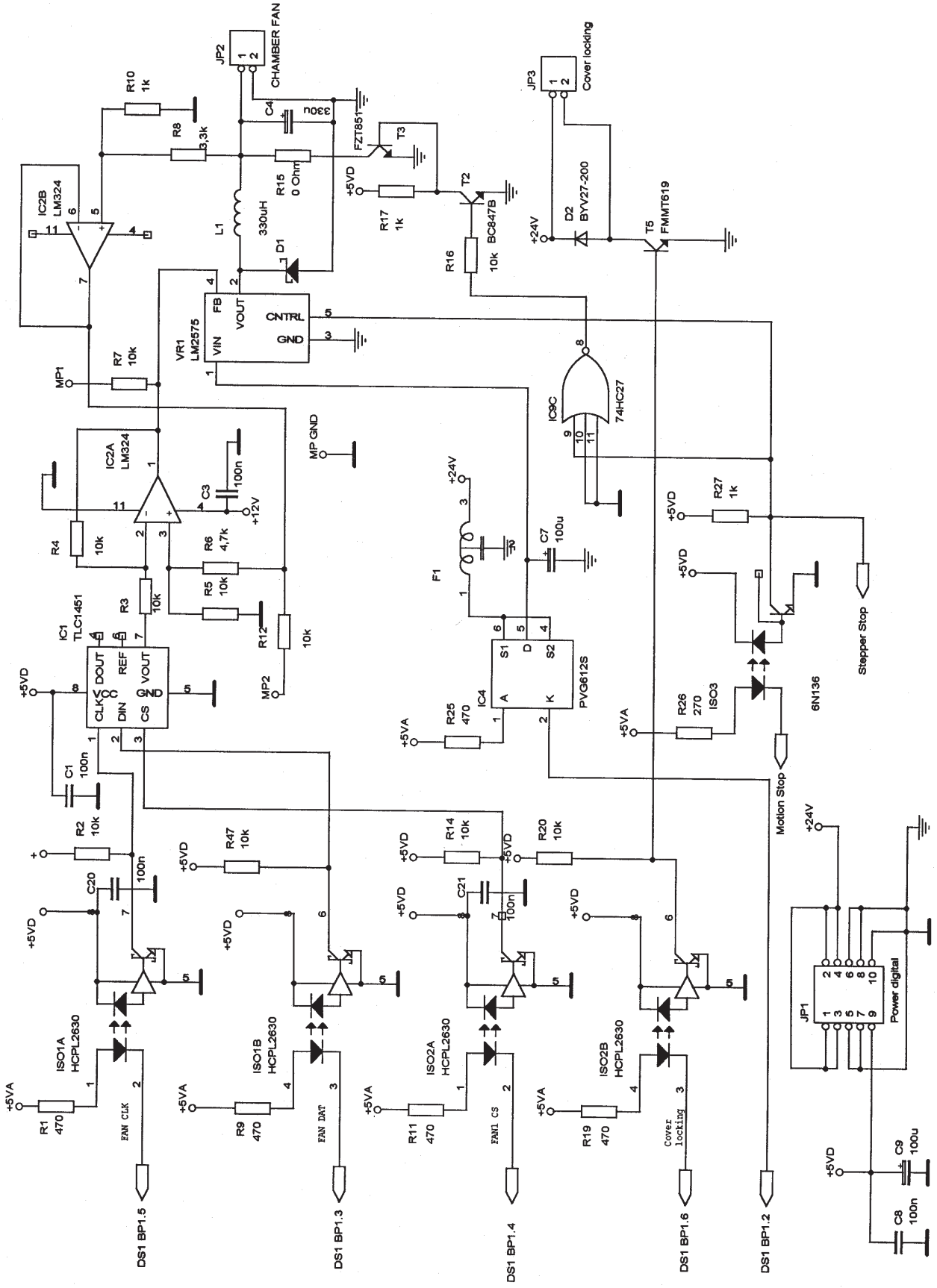


Fig. power-b

### 5.4.3 Printed Circuit Diagram PCB Driver

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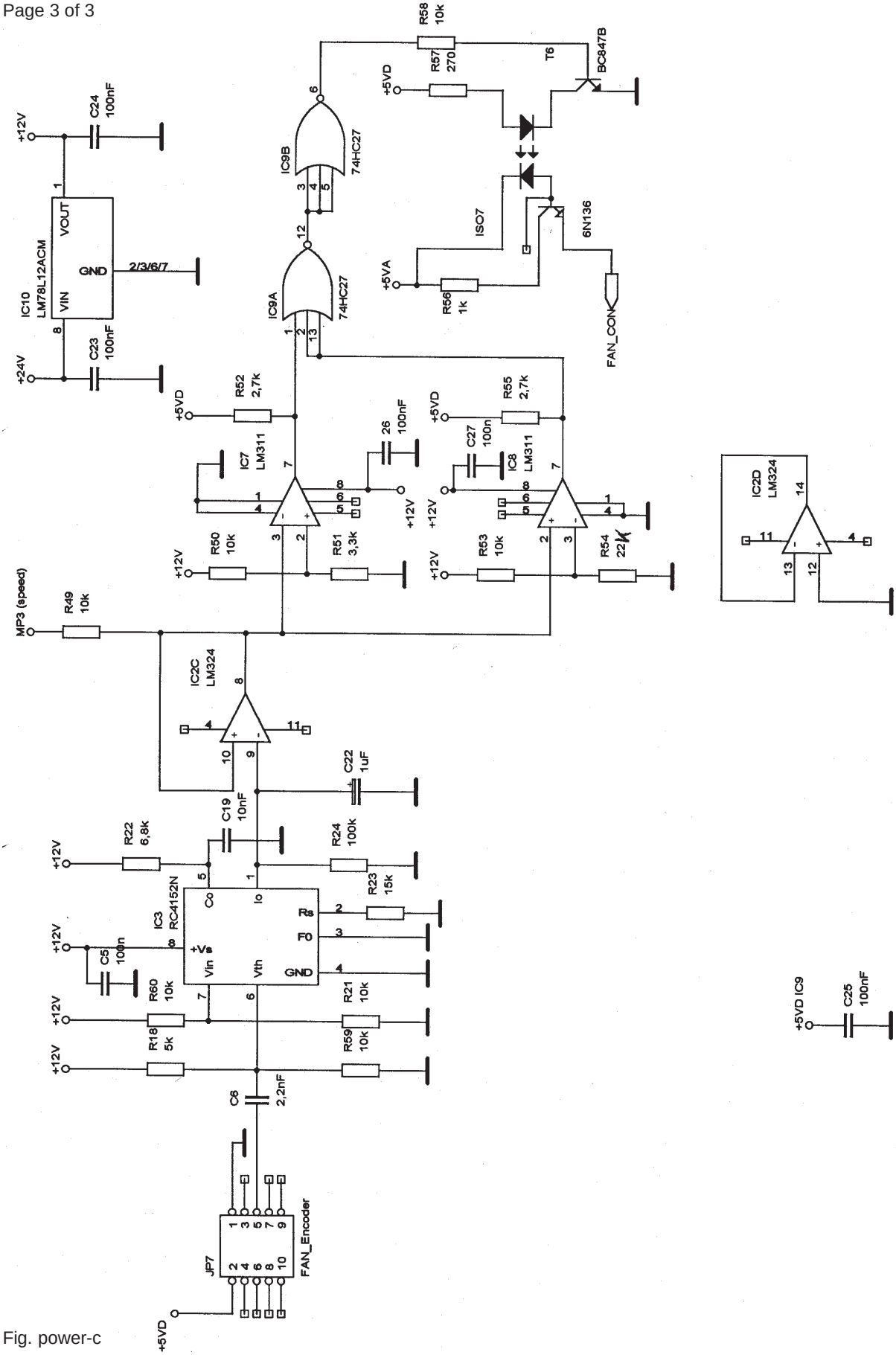


Fig. power-c

### 5.4.4 Layout Diagram PCB Driver

Page 1 of 2

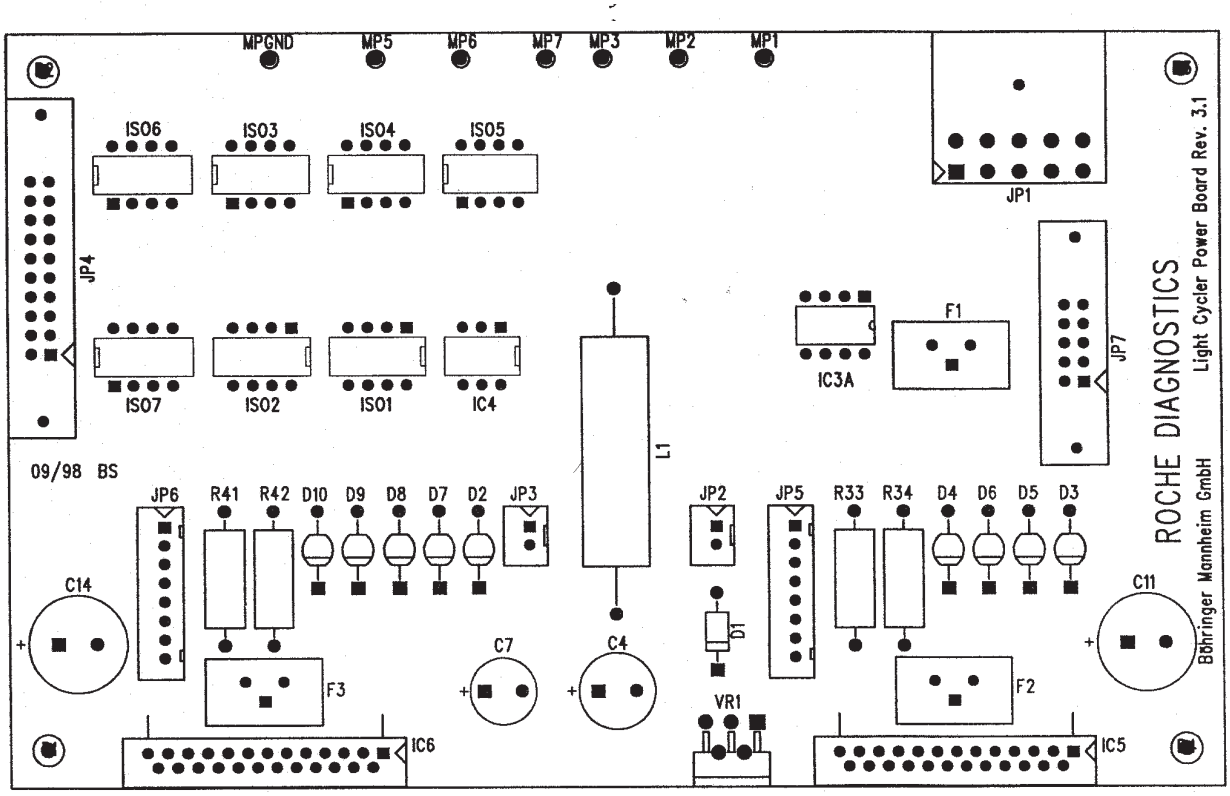


Fig. power-d

### 5.4.4 Layout Diagram PCB Driver

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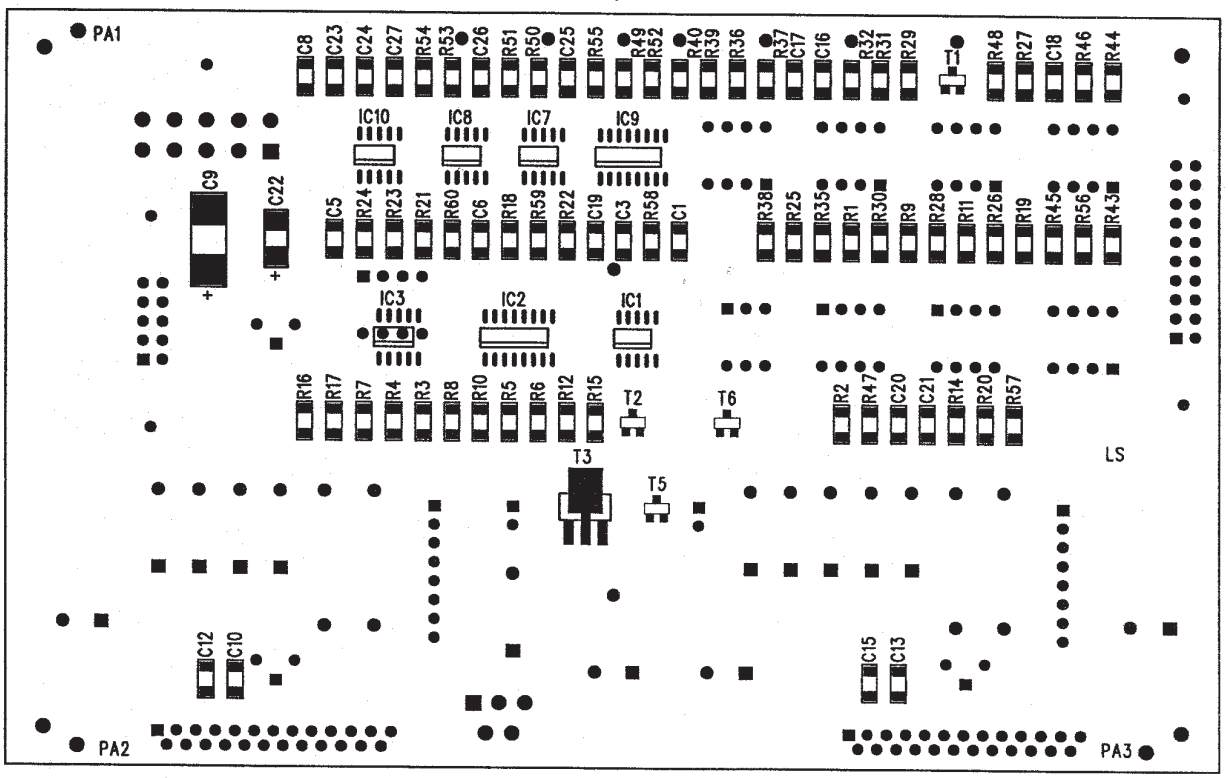


Fig. power-e

## 5.5 Status Board

### 5.5.1 Location

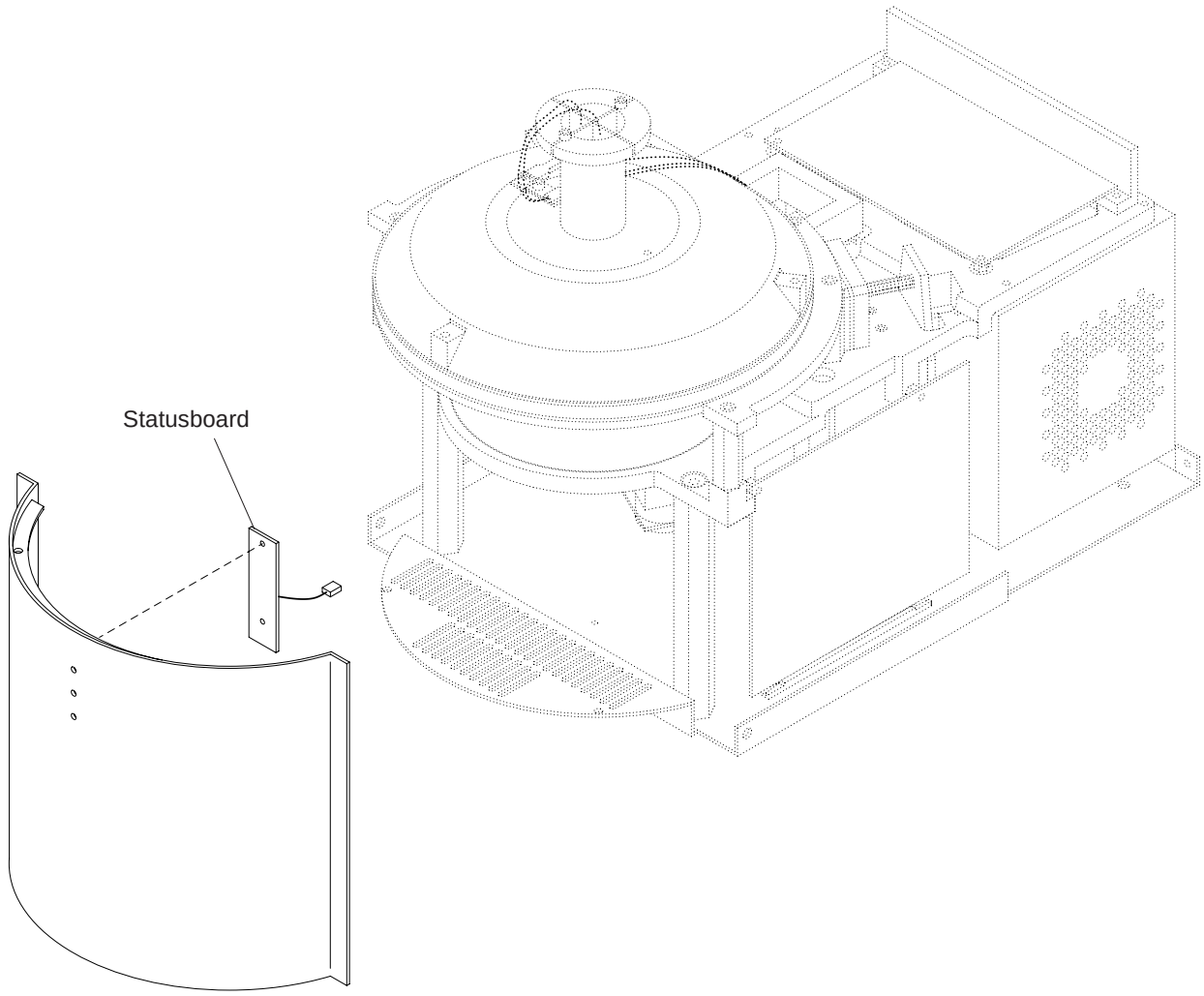


Fig. 221298k3

### 5.5.2 Printed Circuit Diagram Status Board

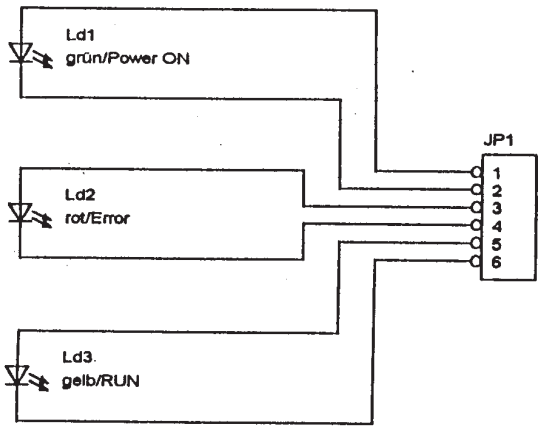


Fig. c5-5-3

### 5.5.3 Layout Diagram Status Board

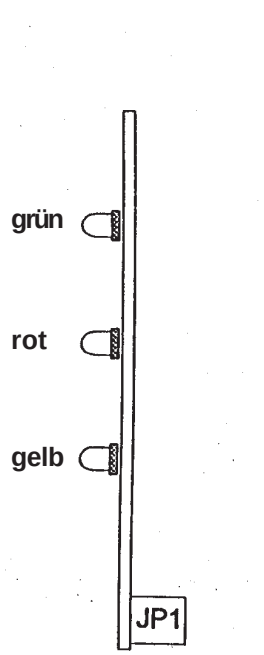


Fig. c5-5-4

## 5.6 Lightbarriers and Sensors

### 5.6.1 Location

**Rotor Lightbarrier**
The rotor lightbarrier controls the rotations of the rotor.

**Interlock Lightbarrier**
The interlock lightbarrier is a reflection lightbarrier. It senses whether the housing lid is open or closed.

**Fluorimeter Lightbarrier**
The fluorimeter lightbarrier controls the fluorimeter movements.

**Monitor Temperature Sensor**
The monitor temperature sensor controls the measuring chamber temperature and prevents excess temperature.

**Control Temperature Sensor**
The control temperature sensor controls excess temperature in the measuring chamber.

**Excess Temperature Switch**

The excess temperature switch is a bimetal switch which protects the Light Cycler from overheating, e.g due to excess operating periods.

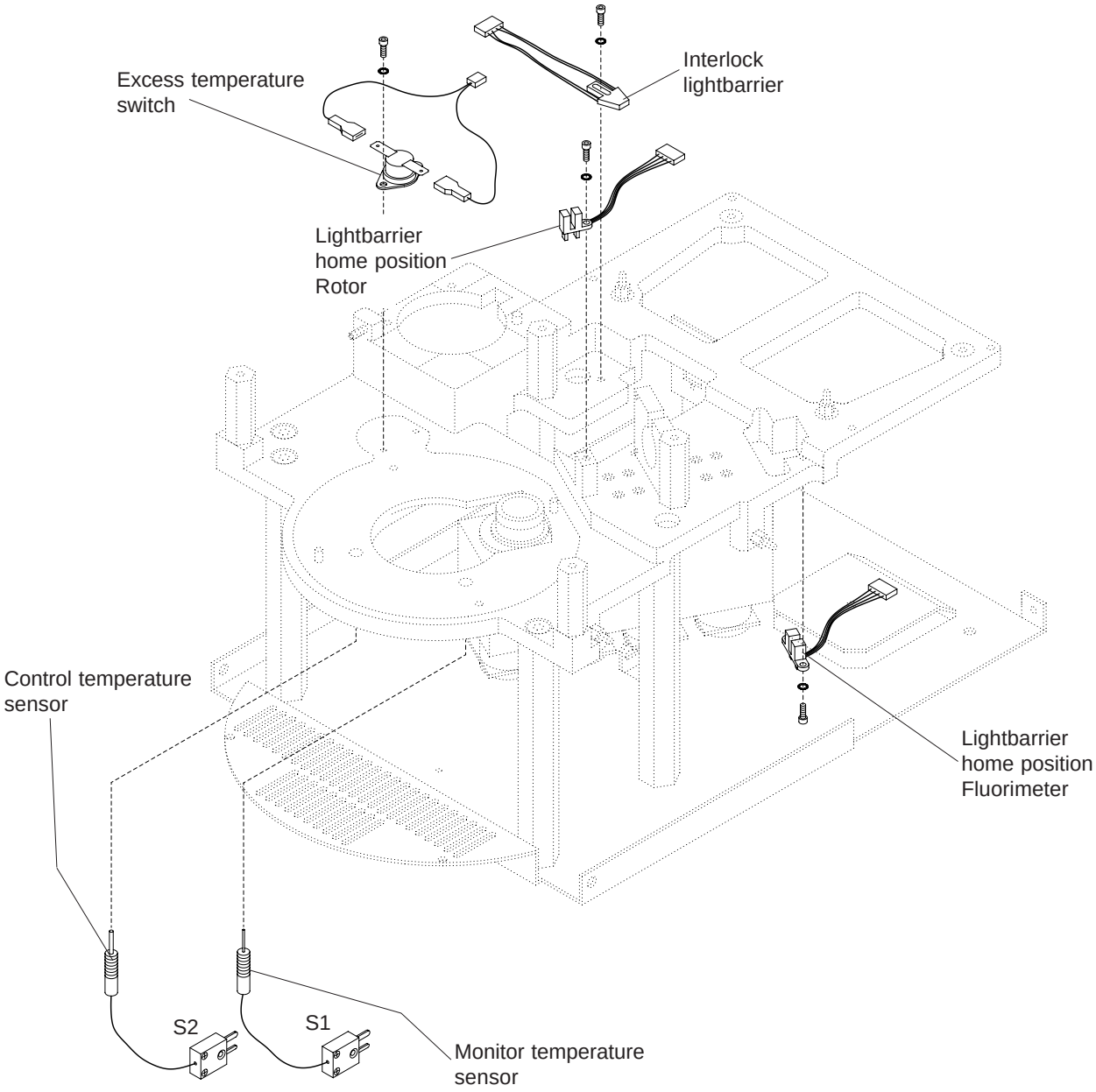


Fig. cap5-6

## 5.7 Power Supply

### 5.7.1 Location

**Functional Description of the LightCycler Power Supply**

The power supply is a functional unit and is accommodated in a metal housing closed on all sides. It is connected to the mains by means of an integrated rubber connector. Fuses are "off limits" to the customer because all outputs are short-circuit proof. A blown fuse is an indication of a defect that cannot and should not be fixed by the customer.

The power supply has three output plugs:

- a 12-pin plug with the following outputs:
  - 5 V for the supplying of digital functions on the PCB controller.
  - +/- 12V for the supplying of analog switching functions on the PCB controller; furthermore for serial data transfer for the supplying of the heating element integrated in the power supply.

- a 10-pin plug with the following outputs:
  - 5V for the supplying of digital functions on the power board.
  - 24V as driver voltage for the stepper motor drivers and the chamber fan driver.

- a 2-pin plug for connecting the heating element; voltage range of this output: 0 - 90V DC.

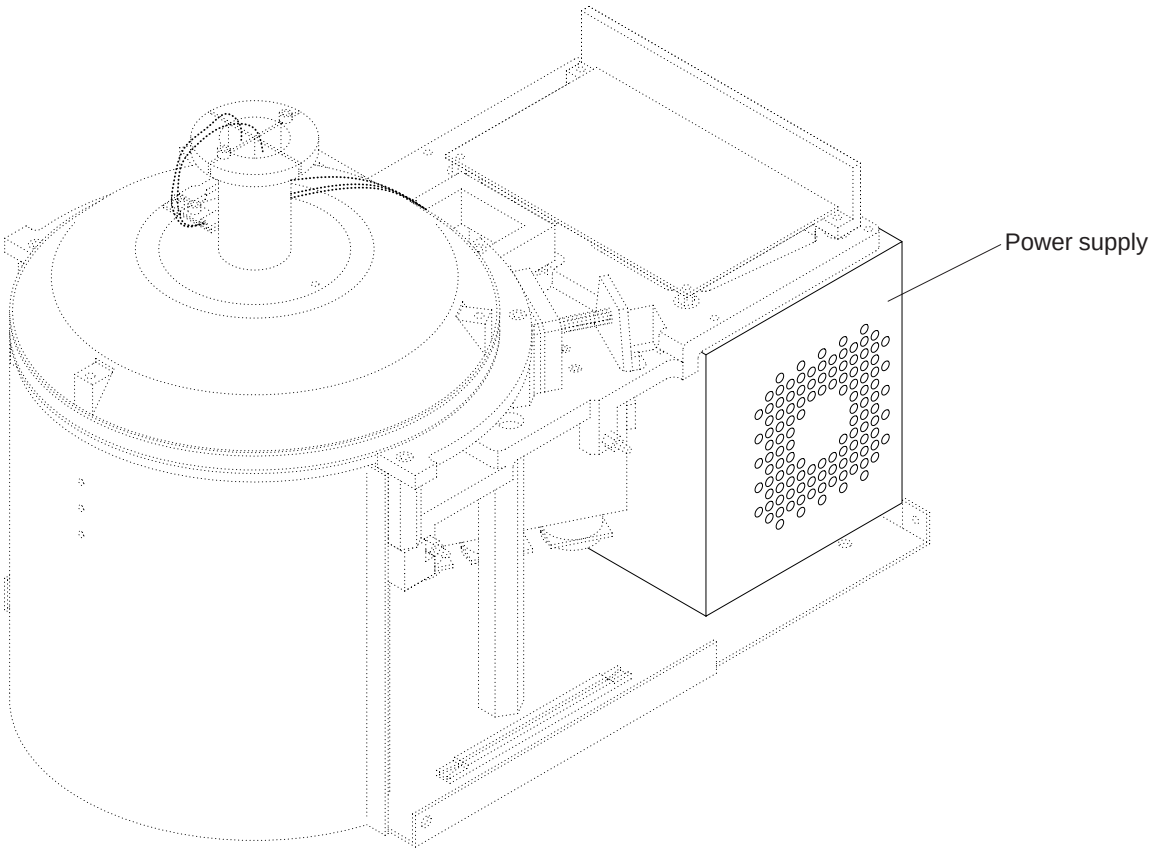


Fig. 221298k4

## 5.8 Heating Element

### 5.8.1 Location

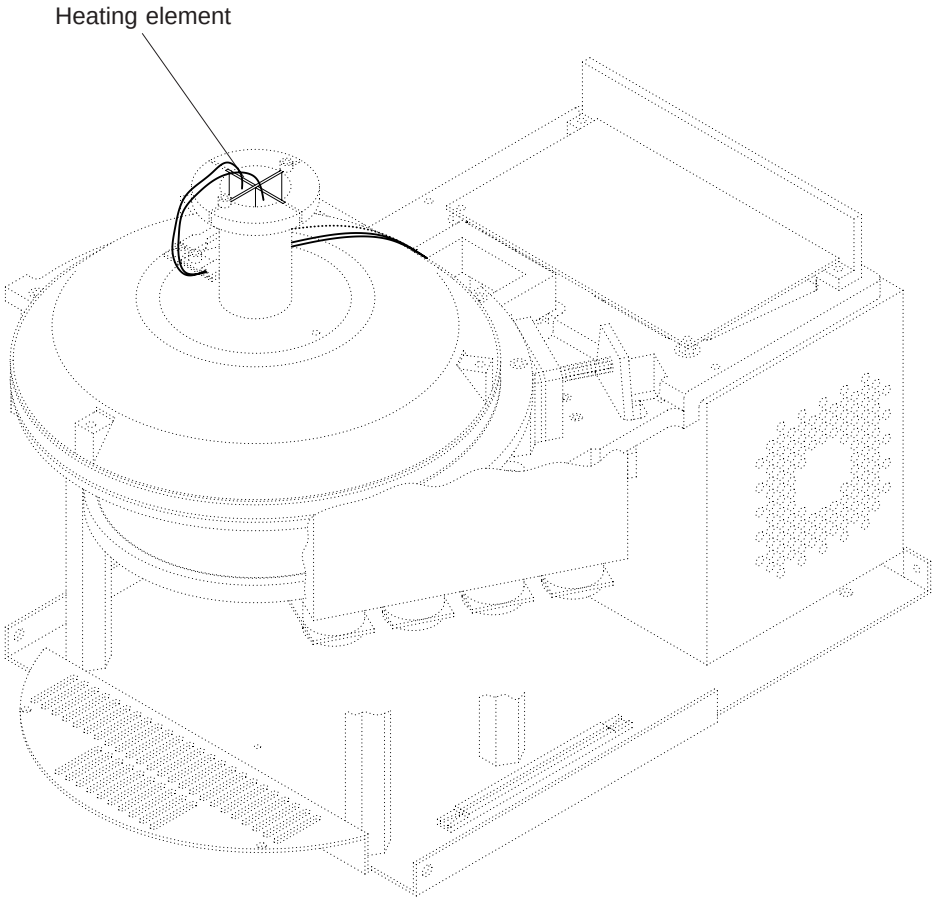


Fig. 240998k2

## 5.9 Fluorimeter

### 5.9.1 Location

**Functional Description of the Fluorimeter**

The fluorimeter is located on a linear bearing below the measuring chamber. It can be moved radially with the help of a linear stepper motor. It has an excitation channel and 3 measuring channels with different wavelengths.
The essential features of the fluorimeter are its metallic body with a system of optical lenses and filters and 4 printed circuit boards with the following functions:

- a LED PCB with a blue light emitting diode for illuminating the capillaries.

- three identical printed circuit boards with optohybrids (photodiode with integrated amplifier) and programmable amplifiers.
  A 12 bit analog-to-digital converter is used for programming the amplifiers as well as for the offset adjustment, with which a negative output value of the optohybrids can be corrected.
  Both 12 bit analog-to-digital converters are accommodated in a housing and are serially activated via a 24 bit string.
  For activating and transferring the measuring values, the fluorimeter PCBs are connected to the PCB controller with a cable (plug JP1 on PCB controller).

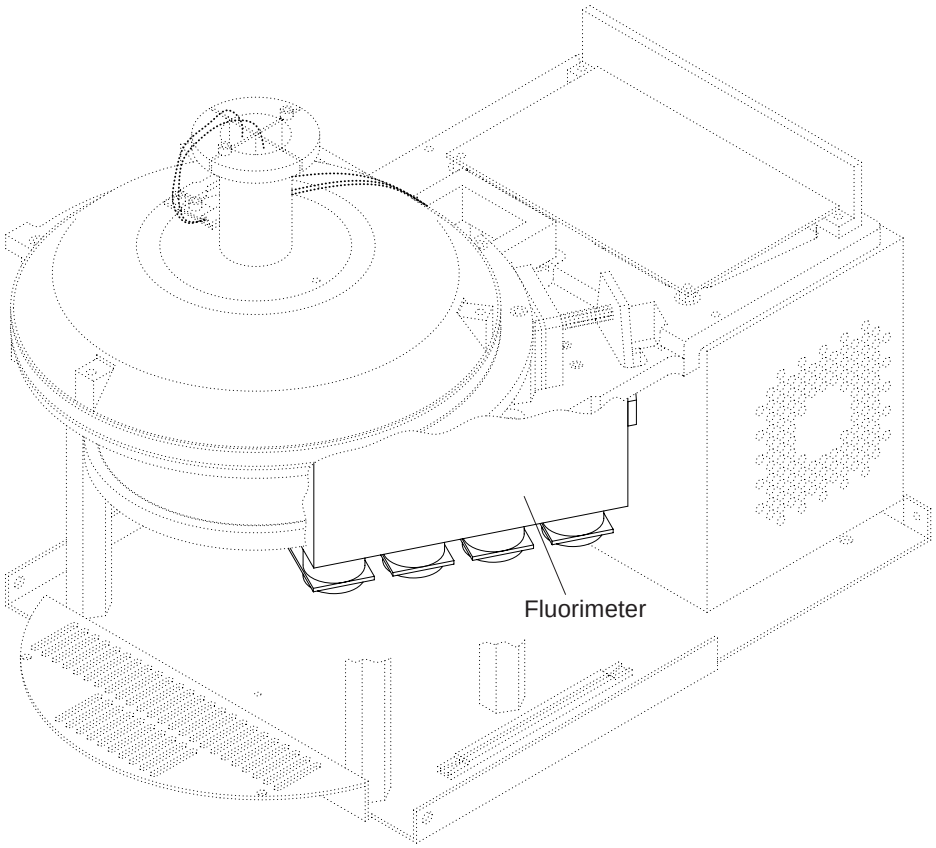


Fig. 221298k2

### 5.9.2 Block Diagram Fluorimeter

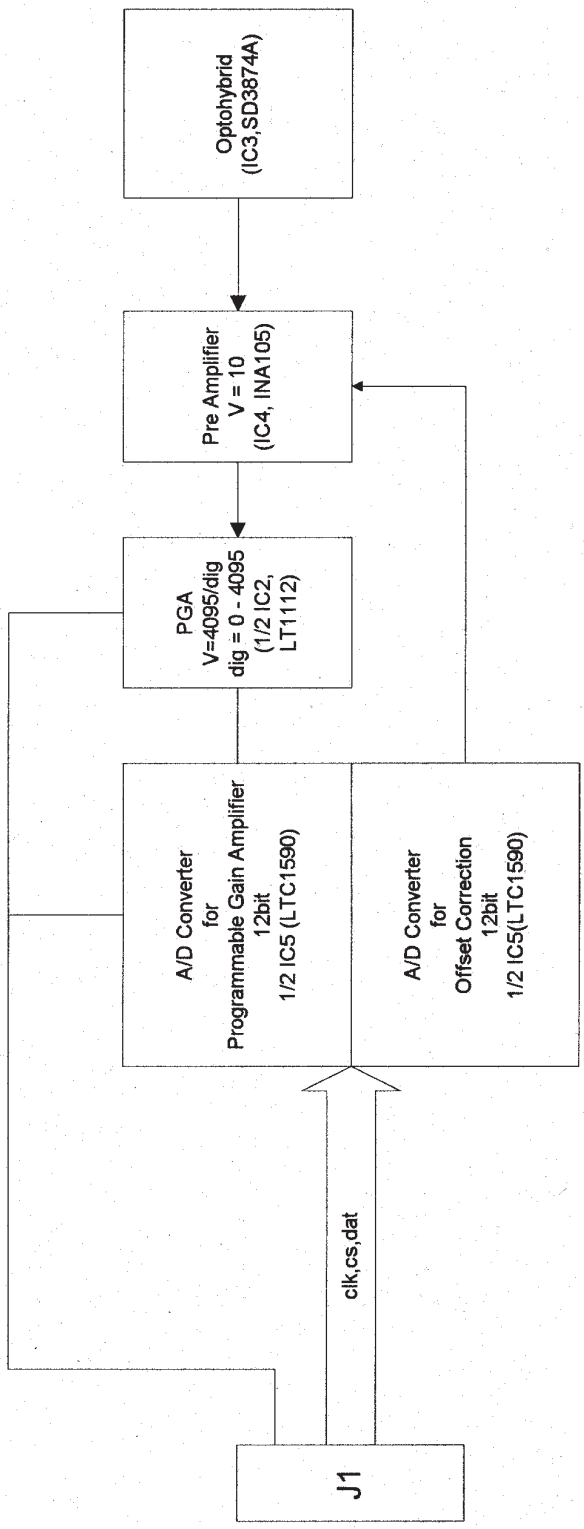


Fig. cap5-9-2

### 5.9.3 Printed Circuit Diagram PCB Fluorimeter

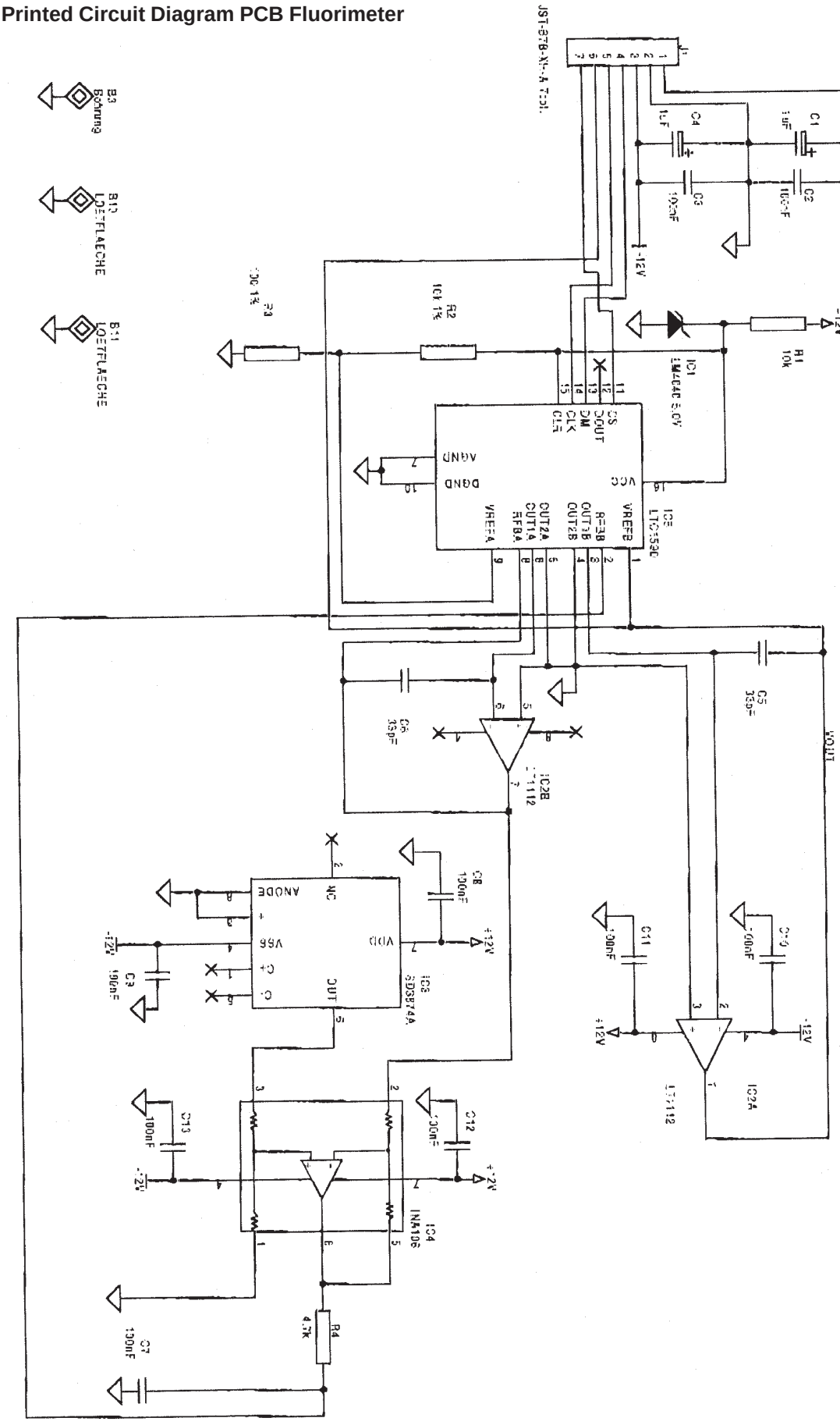

Fig. flour-a

### 5.4.4 Layout Diagram PCB Fluorimeter

Page 1 of 2

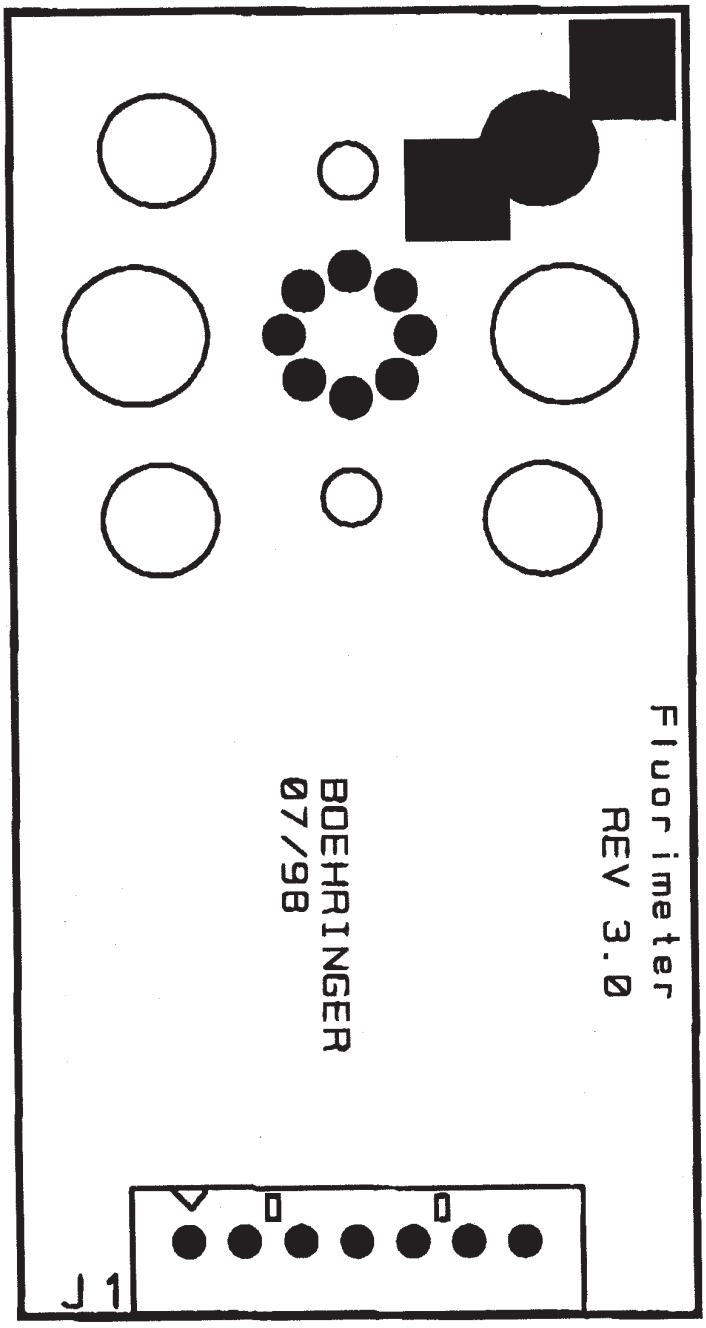


Fig. flour-b

### 5.4.4 Layout Diagram PCB Fluorimeter

Page 2 of 2

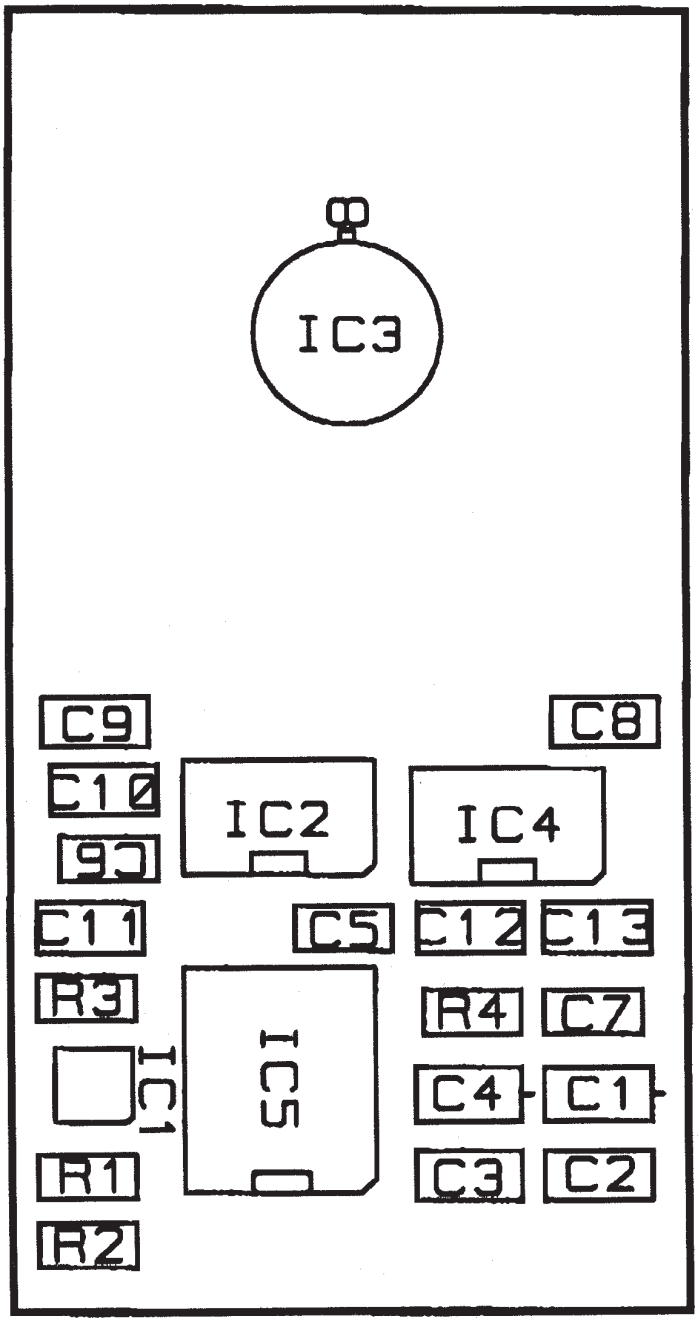


Fig. fluor-c

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### 6.4.5 Set system parameters 2

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#### 6.4.6.1 Change Administrator password 3

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### 6.5.2 Regional settings 3

## 6.6 Setup LC_Service account 3

### 6.6.1 Desktop properties 3

### 6.6.2 Reginonal settings 4

## 6.7 Install LightCycler service and customer software 4

# 6 Service Software

## 6.1 Hardware requirements

This chapter descripes the minimal system to control the LightCycler:

Vectra VE4 5/200 MMX Modell 3200 Desktop
HP# D5606N

- Intel Pentium MMX Processor, 200 MHz
- 64 MB SDRAM DIMM
- 3,2 GB Ultra-ATA/33 Hard disk
- On-board PCI-Video: S3 Trio 64 V2, 2MB 50ns DRAM
- 24-times Speed IDE CD-ROM drive
- Keyboard and PS/2 Mouse
- Operatingd system:
  Windows NT 4.0 inclusive service pack 3 and hotfixes, english version

Internal Iomega ZIP-drive, IDE-interface (ATAPI)

HP Ergo 1280, 17” Monitor (HP# D2840A)

Optional component not generally supplied with the instrument:

HP DeskJet 890C, Color InkJet printer

## 6.2 Installation of Windows NT

During installation of Windows NT the following parameters should be set:

- Display mode settings:
  1024*768 pixels, 256 colors, small fonts
- Hard disk format:
  one NTFS partition

## 6.3 BIOS Settings

This parameters are recommended. The changed boot priority is the best protection against boot viruses.

Advanced ->
Boot-time diagnostic screen: disabled

Boot ->
Boot device priority ->
1. Hard disk
2. Removable devices
3. ATAPI CD-ROM device

## 6.4 Basic setup actions

### 6.4.1 Logon as administrator

Logon User name: Administrator
Password: *****

Only “Password never expires” should be marked!

### 6.4.2 Create directory and set run mode of a program

Start the explorer and ...

- create folder:
  C:\Users

- select file:
  C:\Winnt\Profiles\AllUsers\Start Menu\Programs\Startup\Iomega Quick Tools NT

with right mouse button -> Properties -> Shortcut
->Run: Mininized -> OK

### 6.4.3 Check desktop properties

Display properties:
Background -> Pattern -> Weave
ScreenSaver -> Logon Screen Saver
Password protected
Wait: 10 min
Settings -> Color palette: 256 colors
Desktop area: 1024 by 768 pixels
Font size: Small fonts
Refresh frequency: 75 Hertz

### 6.4.4 Change the reginonal settings

Start -> Settings -> Control Panel -> Regional Settings

Reginal settings properties:

- Regional settings: english (United States)
- Number -> Measurement System: Metric
- Time -> Time style: HH:mm:ss
- Date -> Short date style: dd-MMM-yy
  -> Long date style: dddd, dd MMMM, yyyy

-> OK

### 6.4.5 Set system parameters

Start -> Settings -> Control Panel -> System

- Startup/Shutdown -> System startup -> Show list for 3 seconds
- Recovery -> Write an event to the system log
  -> Automatically reboot

#### 6.4.6 Set administrator password/create LC_Service and LC_User account

Start -> Programs -> Administrative Tools (Common) -> User Manager

##### 6.4.6.1 Change Administrator password

Double click “Administrator” ->

Password: ******
Confirm Password: ******

-> OK

##### 6.4.6.2 Create LC_Service account

Select “ Administrator” -> User -> Copy

Username: LC_Service
Full name: LightCycler Service
Description: -
Password: ******
Confirm password: ******

Only “Password never expires” should be marked !

-> Groups -> Member of: Administrators
-> OK
-> Profile -> Home directory -> Local Path: C:\LC_Service

-> OK -> OK

##### 6.4.6.3 Create LC_User account

-> User -> New User

Username: LC_User
Full name: LightCycler User
Description: -
Password: *****
Confirm password: *****

Only “Password never expires” should be marked !

-> Groups -> Member of: Poweruser
-> OK
-> Profile -> Home directory -> Local Path:
C:\Users\LC_User
-> OK -> OK

-> Exit

Start -> Shutdown -> Close all programs and logon as different user -> YES

### 6.5 Setup LC_User account

Logon as LC_User:

CTRL + ALT + DEL -> Logon window:

Logon User name: LC_User
Password: *****

#### 6.5.1 Desktop properties

Display properties:
Background -> None / None
ScreenSaver -> Starfield Simulation
No Password protection
Wait: 15 min

#### 6.5.2 Regional settings

Start -> Settings -> Control Panel -> Regional Settings

Reginal settings properties:

- Regional settings: english (United States)
- Number -> Measurement System: Metric
- Time -> Time style: HH:mm:ss
- Date -> Short date style: dd-MMM-yy
-> Long date style: dddd, dd MMMM, yyyy

-> OK

### 6.6 Setup LC_Service account

Logon as LC_Service:

CTRL + ALT + DEL -> Logon window:

Logon User name: LC_Service
Password: *****

#### 6.6.1 Desktop properties

Display properties:

Background -> Pattern -> None
Wallpaper -> LcService -> Display: Tile
ScreenSaver -> Logon Screen Saver
Password protected
Wait: 15 min
Settings -> Color palette: 256 colors
Desktop area: 1024 by 768 pixels
Font size: Small fonts
Refresh frequency: 75 Hertz

### 6.6.2 Reginonal settings

Start -> Settings -> Control Panel -> Regional Settings

Reginal settings properties:

- Regional settings: english (United States)
- Number -> Measurement System: Metric
- Time -> Time style: HH:mm:ss
- Date -> Short date style: dd-MMM-yy
  -> Long date style: dddd, dd MMMM, yyyy

-> OK

## 6.7 Install LightCycler service and customer software

Logon as LC_Service:

CTRL + ALT + DEL -> Logon window:

Logon User name: LC_Service
Password: *****

After logon process is ready insert LightCycler service CD-ROM. The setup routine of ServiceTools starts after some seconds automaticallly. -> Next -> Next -> Finish

Please copy the links of the little LC_Service window to the desktop (TestAdj and LcEdit).

The setup of the customer software must be started with the command Drive:\LightCycler\Setup.exe

# 7 Troubleshooting

| Error Description | Possible Reason`s | What To Do |
|---|---|---|
| - Chanber fan or rotor stepper are not running | - Interlock sensor not adjusted<br>- reflex area at the lid is not shiny<br>- Sensor defect | - check output from sensor: voltage on pin3 from JP6 must be 0.2V(+0.2), if the lid is closed (if open, then +5V)<br>- control the reflex are and clean it if necessery<br>- change and adjust the light barrier |
| - no heating function | - seeabove about interlock sensor<br>- the heating coil is broken<br>- the power supply for heating is out of order<br>- the overheat latch is seted | - see above<br>- change the heating coil<br><br>- check pin8 from IC14 (must be +5V if the cover is closed), if not then check pin7 from IC23 and IC24 (both must be low, if not, a overheat is detected) |
| - no flourimeter signal on all channel`s | - the blue LED dosent work | - check the blue LED from Photometer<br>- check the interlock sensor |

cap7.tbl

# 8 Spare Parts 2

## 8.1 Part Identification 2

## 8.2 Complete Spare Part List 3

## 8.3 Tools 4

# 8 Spare Parts

## 8.1 Part Identification

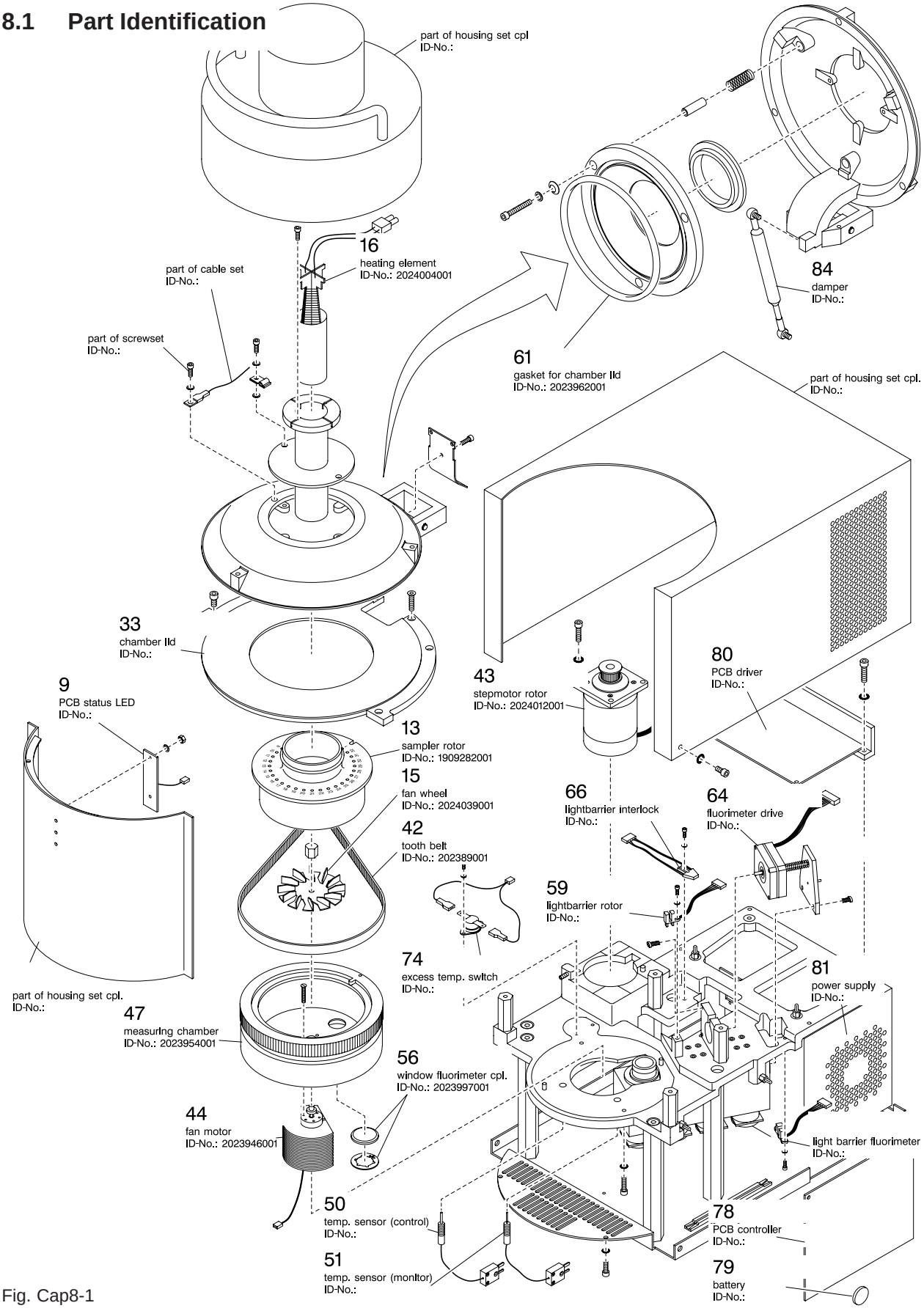


Fig. Cap8-1

## 8.2 Complete Spare Part List

| ID Spare Part | Partname | BTO | R | A | ABC | Reference No. |
|---|---|---|---|---|---|---|
| 1909282001 | Samplerotor | | | | | 13 |
| 2024039001 | Fan Wheel | | | | | 15 |
| 2024004001 | Heating Element | | | | | 16 |
| 2023962001 | Gasket for Chamber Lid | | | | | 61 |
| | Chamber Lid | X | | | | 33 |
| 2024012001 | Stepmotor (Rotor) | | | | | 43 |
| 2023989001 | Tooth Belt | | | | | 42 |
| | PCB Driver | | | | | 80 |
| | PCB Controler | | | | | 78 |
| | Power Supply | | | | | 81 |
| | Fluorimeter Drive | | | | | 64 |
| 2023946001 | Fan Motor | | | | | 44 |
| | Temperature Sensor (Control) | | | | | 50 |
| | Temperature Sensor (Monitor) | | | | | 51 |
| 2023954001 | Measuring Chamber | | | | | 47 |
| 2023997001 | Window Fluorimeter | | | | | 56 |
| | PCB Status LED | | | | | 9 |
| | Lightbarrier Rotor | | | | | 59 |
| | Lightbarrier Interlock | | | | | 66 |
| | Excess Temperature Switch | | | | | 74 |
| | Lightbarrier Fluorimeter | | | | | 70 |
| | Battery | | | | | 79 |
| | Damper | | | | | 84 |
| | Housing Set cpl. | | | | | |
| | Screwset | | | | | |
| | Cable Set | | | | | |

Fig. cap8-2

## 8.3 Tools

| | |
|---|---|
| Allan key | 2.0 mm |
| | 2.5 mm |
| | 3.0 mm |
| | 4.0 mm |
| Wrench | 4.5 mm |
| | 7 mm |
| | 8 mm |
| | 14 mm |
| Socket spanner | 4.5 mm |
| | 5.5 mm |
| Phillips screwdriver | size 1, length 100 mm |
| | size 0, length 100 mm |
| Snap ring pliers | 10 - 25 mm for window photometer |

# 10 Maintenance

The Light Cycler is a maintenance-free instrument. Keep the instrument surface and the outer parts of the instrument clean for hygienic reasons. Use a commercial detergent or disinfectant, preferably 70% isopropanol, if necessary.